ANNALS

OF

The Entomological Society of America

VOLUME XXVI, 1933

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ANNALS
OF
The Entomological Society of America

Volume XXVI MARCH, 1933 No. 1

AN OBSCURE TEMNOSTOMA DIFFERENTIATED BY ITS LARVAL CHARACTERS[1]

(Syrphidae: Diptera.)

C. L. METCALF,
University of Illinois.

On March 26, 1929, I received from Mr. L. E. Hildebrand, of New Trier High School, Winnetka, Illinois, a small piece of decayed wood containing some peculiar-looking larvae and a letter with this comment:

> "I have roamed over these woods almost a fifth of a century, and I have never run across exactly that kind of larvae. Furthermore, I have dug through, time and again, all sorts of logs and stumps, hence my interest at finding these things."

I recognized them at once as larvae of Syrphidæ and comparison with specimens of puparia in my collection, reared from a water-soaked willow log by A. B. Champlain, of the Pennsylvania Department of Agriculture, showed that they belonged in the *Temnostoma bombylans* group. In response to my request, Mr. Hildebrand shipped me on March 27, a 90-pound box of the wood and wrote as follows:

> "Sorry we could not find any such rich chunks as those we had before. The boys in their enthusiasm had torn the log up into rather small pieces. This log was merely a chunk about 3 feet long and perhaps 6 or 8 inches in diameter. Since we were seriously dissatisfied with results there, we went on through the woods and finally found another log of small size (hard maple

[1]Contribution from the Entomological Laboratories of the University of Illinois, No. 145.

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like the first one) and in it we found a few and loaded parts of it up with the rest. These logs were in rather damp flat places in the woods. The bark in each case was still somewhat intact."

Since the material sent contained about a hundred larvae the insects must have been very numerous in the rich chunks first found.

In this material I found two kinds of larvae, superficially alike (Plate I, Fig. G), but differing so constantly in details of structure that there could be no doubt that they were distinct species. They were living side by side in adjacent tunnels in the same chunks of wood and were absolutely indistinguishable except by microscopic examination. Transformation of the two kinds of larvae to adults was awaited with the keenest anticipation. The two kinds of larvae yielded adults so similar that I was almost persuaded there had been some confusion in my cages. As more material accumulated, however, certain constant differences became evident. From one kind of larvae (Plate 1, Figs. A, C, E) I secured specimens (Fig. H) with prominent tuberculate faces (*m*), with black hairs on fourth and fifth abdominal tergites, with the first abdominal yellow cross-band (*p*) broad, the antennae dark, and the yellow pollinose stripe (*o*) above the base of the wings small or wanting. From the other larvae (Figs. B, D, F) I secured adults (Fig. I) without a facial tubercle, with the fine hairs on the black areas of the abdominal tergites yellowish, with the abdominal cross-bands (*p*) narrow and more arched, the antennae lighter, and a prominent yellow stripe (*o*) above the base of each wing.

I next examined the genitalia of the males feeling confident that prominent differences would be found in these parts, since the male genitalia of Syrphidæ are usually abundantly rich in characters. The differences here, although minute, are constant and sufficient to confirm the separation of the species.

Having determined that two species were involved, the next problem was what to call them. *Temnostoma bombylans* Fabricius was named from European material. Malloch (1922) considered that *bombylans* (which name he incorrectly attributes to Linné) does not occur in America and that American material designated as *bombylans* should be called *obscura* Loew. Johnson

(1925) commenting on Malloch's paper says: "His determination of *T. obscura* Loew, however, is wrong, the latter being a synonym of *T. bombylans* Fabricius. The *T. obscura* as defined by Malloch is evidently the *Syrphus* (*Doros*) *balyras* Walker (List of Dipt., pt. 3, p. 577, 1849), as the following notes from Walker's description would indicate: 'Feelers and their bristles bright tawny, . . . abdomen adorned with four slightly arched yellow bands, . . . legs yellow, four hind thighs with broad black bands, hind shanks pitchy towards the tips.' No mention is made of the dark terminal joints of the tarsi which are as conspicuous in *T. bombylans* as the 'pitchy' band toward the tips of the hind tibiae."

The characters used by Malloch to separate the European *bombylans* from the American material he called *obscura* Loew—in this paper designated *balyras* (Walker)—were the brown, shorter and stronger hairs on the fourth tergite and base of hypopygium, and the black apical segments of mid- and hind tarsi. Presumably he had no American material with black hairs on the fourth tergite and dark terminal segments of the mid- and hind tarsi. I have such specimens from Maine and C. W. Johnson has sent me such specimens from Massachusetts. We shall therefore call such American material *bombylans*, until other evidence is presented that this is not identical with the European *bombylans*. If it proves to be distinct it should apparently be called *obscura* Loew. The other American species called *obscura* by Malloch is, following Johnson's opinion, herein called *balyras* (Walker). A third species, *T. trifasciata* Robertson, is clearly differentiated in Malloch's and Johnson's papers and was not involved in my material. The present paper, therefore, is concerned with the clearer differentiation of *T. bombylans* Fabricius (American material) from *T. balyras* (Walker) and the description of larvae and puparia of each species.

Specimens of this group have been reared from a decaying hickory log near Washington, by H. S. Barber (1913), who expresses the opinion that about four species are involved in America under the name *Temnostoma bombylans*. He does not describe the larvae or differentiate them.

The differences in the adults and larvae of the two species I have reared may be tabulated as follows:

T. bombylans Fab. (*T. obscura* Loew?)	*T. balyras* (Walker).
Adult male. (Pl. I, Fig. H; Pl. II, Fig. A.)	*Adult male.* (Pl. I, Fig. I.)
Face prominent, tuberculate.	Face nearly straight below antennae, without a tubercle.
First yellow cross-band of abdomen wider than in *balyras* and wider at the sides than at the middle.	First yellow cross-band narrower than in *bombylans* and strongly narrowed toward each side.
Longitudinal yellow pollinose stripe above base of wing wanting or very small.	This stripe nearly as large as the transverse stripe in front of it.
Hairs on third and fourth abdominal segments behind the yellow bands mostly black.	Hairs on third and fourth abdominal segments behind the yellow bands mostly yellow.
Eyes a little more widely separated in front of ocelli.	Eyes more nearly contiguous.
Third segment of antenna brownish.	Third segment of antenna light yellow.
Last two tarsal segments of middle and hind legs brown or black.	Tarsi of middle and hind legs usually entirely yellow.
Adult female.	*Adult female.*
Frons broader, about one-fifth total width of head.	Frons narrower, about one-sixth total width of head.
Yellow pollinose bands margining eyes in front narrower.	Yellow pollinose bands margining eyes in front broader, nearly meeting in front of ocelli and again half way to antennae.
Face much longer and more prominent.	Face much shorter.
Small hairs on black areas of 3rd, 4th and 5th abdominal tergites black.	These hairs mostly yellowish.
Second, third and fourth points given above for the males hold for the females, but with less difference.	Second, third and fourth points given above for the males hold for the females, but with less difference.

There is some variation in the color of antennae and tarsi in both males and females and I think these characters much less reliable than the color of the vestiture on the black areas of the fourth and fifth tergites and the shape of the face.

T. bombylans.	*T. balyras.*
Larva. (Pl. I, Figs. A, C and E.)	*Larva.* (Pl. I, Figs. B, D and F.)
One prominent, sharp, marginal tooth (*a*) on each stigmal plate, or half of the posterior respiratory organ; namely, the one ventrad of the third palmate hair (*b*). (Figs. A and C.)	Each stigmal plate or half of the posterior respiratory organ with eight equivalent marginal blunt teeth (*a*, *a*), a pair adjacent to each of the four interspiracular palmate hairs (*b*, *b*). (Figs. B and D.)
The third palmate hair on each side much more prominent, erect, stouter.	All of the palmate hairs or interspiracular ornaments of equal size.
Stigmal plates fused along the ventral fourth, with an erect dorsally-curved tooth (*e*) on the median line.	Stigmal plates completely, narrowly separated; no ventral median tooth.
Slit-like spiracles (*d*, Fig. C) longer, with their chitinous expansions averaging about eleven to each spiracle.	Slit-like spiracles (*d*, Fig. D) shorter, their chitinous expansions averaging about four to each spiracle.
Buttons (*c*) or circular plates larger.	Buttons (*c*) or circular plates smaller.
Prothoraic rakes heavier, with seven or eight teeth in each of the three rows. (Fig. E.)	Prothoracic rakes lighter, the teeth usually being five in the median row, six in the middle row and six or seven in the lateral row. (Fig. F.)
Prothoracic larval spiracles oval. (*f*, Fig. E.)	Prothoracic larval spiracles with a lateral expansion at the dorsal extremity. (*f*, Fig. F.)

For terminology of the parts as used above see Metcalf (1919).

All of the characters given for the larvae can be used to separate the species during the pupal stage, as they remain recognizable on the puparium.

The full grown larva of *T. balyras* (Fig. G), as also that of *bombylans*, is about half an inch long by one-eighth inch in diameter. The larva is milk-white except for the prothoracic rakes (*g*), with the adjacent spiracles, and the last segment with the posterior respiratory organ (*h*). There are eight principal body segments, each with several transverse wrinkles and of nearly equal size, besides those of reduced size at the extremities. The head segments are directed ventrad, the inconspicuous mouth parts and rudimentary antennae or sensory papillæ lying about 1 mm. back on the ventral side. The prothoracic rakes thus lie at the anterior extremity. Their

structure is shown by the figures E and F. The rakes measure from 0.6 mm. to 1 mm. across and are separated by about twice their width. At the middle of the somewhat truncate caudal extremity arises the posterior respiratory organ which is elevated less than half a millimeter. Its diameter is about 1 mm. Its structure in each of the species is shown by the figures A, C, B, D, of Plate I.

The wood in which the larvae were found was very moist, still firm, but so far decayed that it could be broken apart by the unaided hands with some difficulty. The larvae made clean galleries through the wood, those made by the mature larvae being about one-eighth inch in diameter. Within these the larval body fits very snugly. The galleries are extended or burrowing is done by the prothoracic rakes. The anterior end of the body is forced against the blind end of the burrow, the rakes are brought toward the median line so that their teeth point forward. Then the anterior three or four larval segments are contracted, at the same time pulling the rakes laterad and crowding the torn wood along the sides of the body between them and the walls of the galleries. Such scrapings are repeated at intervals of 4 or 5 seconds, when the larva is actively burrowing, and the gallery may be extended twice the length of the larval body in about fifty minutes.

The galleries are kept quite clean of the burrowings (Plate II, Fig. C).

Pupariation takes place with the anterior end of the body nearly flush with the surface of the log (Plate II, Fig. D). The pupal respiratory horns (*t*, Fig. D) are slightly more than half a millimeter long by about one-third millimeter in diameter, polished brown, nearly cylindrical, bluntly rounded at apex and dotted with minute respiratory apertures. They appear to be very similar in the two species.

From material collected in late March and subsequently kept in the laboratory at about 70° F. adults of both species emerged the latter half of April. *T. bombylans* is common in New England from mid-June to mid-July. I have specimens reared at Harrisburg, Pennsylvania, by Champlain. They emerged in mid-May. I have specimens of *T. balyras* from Ohio, and Johnson has sent me specimens from New Hampshire, collected June 11 and 21. Johnson (1925) records specimens

from the Harris collection, of *T. bombylans* from Dublin, N. H., June 2, 1822, and of *T. balyras* from New Hampshire, July, 1835, and from Maine, 1836. Both species have evidently been long established in America and both are probably widely distributed.

The occurrence of two so closely related species in the very same habitat leads one to wonder whether these are species that have recently differentiated from each other; or whether the resemblance is due to convergence of characters brought about by their identical habitat; and indeed whether crossing may not take place in nature.

LITERATURE CITED.

Barber, H. S. 1913. Notes on a Wood-boring Syrphid. Proc. Entomo. Soc. Wash. **15**: 151, 152.

Johnson, Charles W. 1925. Diptera of the Harris Collection. Proc. Boston Soc. Nat. Hist. **38**: 84, 85.

Malloch, J. R. 1922. *Temnostoma bombylans* Linne, Doubtfully American, (Diptera, Syrphidae). Entomo. News, **33**: 278.

Metcalf, C. L. 1919. A Proposed Nomenclature for the Parts of the Posterior Respiratory Apparatus of Dipterous Larvae and a Micro-protractor useful in their Description. Psyche, **26**: 53–58, pl. 1.

EXPLANATION OF PLATES.

PLATE I.

Fig. A. Left lateral aspect of posterior respiratory organ of *Temnostoma bombylans* to show the one prominent tooth (*a*) of each stigmal plate and how the third palmate interspiracular hair (*b*) overshadows the others.

Fig. B. Left lateral aspect of posterior respiratory organ of *Temnostoma balyras* to show the eight, low-lying, equivalent teeth (*a*) and interspiracular hairs (*b*, *b*) of this species.

Fig. C. Distal view of the stigmal plates of *Temnostoma bombylans*, showing the relatively large circular plates (*c*) near the center, the partial fusion of the two halves or plates, the relatively long spiracular slits (*d*), the overshadowing third interspiracular hair (*b*) with the adjacent tooth (*a*) and the dorsally-directed tooth (*e*) in the median ventral position.

Fig. D. Distal view of the stigmal plates of *Temnostoma balyras*, showing the complete separation of the two halves, the relatively small circular plates (*c*), short spiracular slits (*d*) and equivalent interspiracular hairs (*b*, *b*) and eight pairs of low blunt teeth (*a*, *a*) around the margin.

Fig. E. Right thoracic rake of *Temnostoma bombylans* showing the three rows of seven teeth each and the adjacent prothoracic spiracle (*f*).

Fig. F. Right thoracic rake of *Temnostoma balyras* showing the fewer teeth arranged in three rows of 5–6–6. The prothoracic spiracle (*f*) has a lateral projection at the posterior end.

Fig. G. Full grown larva of *Temnostoma balyras* (Walker), ventral view, showing at anterior end the two prothoracic rakes (*g*), each with three rows of prominent teeth used in making galleries through wood. The prothoracic spiracle lies immediately cephalomediad of the rake. The mouthparts lie a little way back on the median line with the sensory papillae just in front of them. At the posterior end is the heavily-chitinized posterior respiratory apparatus (*h*). Enlarged about 3.5 times.

Fig. H. *Temnostoma bombylans*, male, in side view to show the prominent tuberculate face (*m*), the obsolete longitudinal spot (*o*) above base of wing and the first yellow cross-band of the abdomen (*p*) widening toward the side. Yellow markings are suggested by dotted lines.

Fig. I. *Temnostoma balyras*, male, in side view to show the straight face (*m*), the prominent longitudinal spot above base of wing (*o*) and the narrower more arcuate yellow abdominal fasciae (*p*).

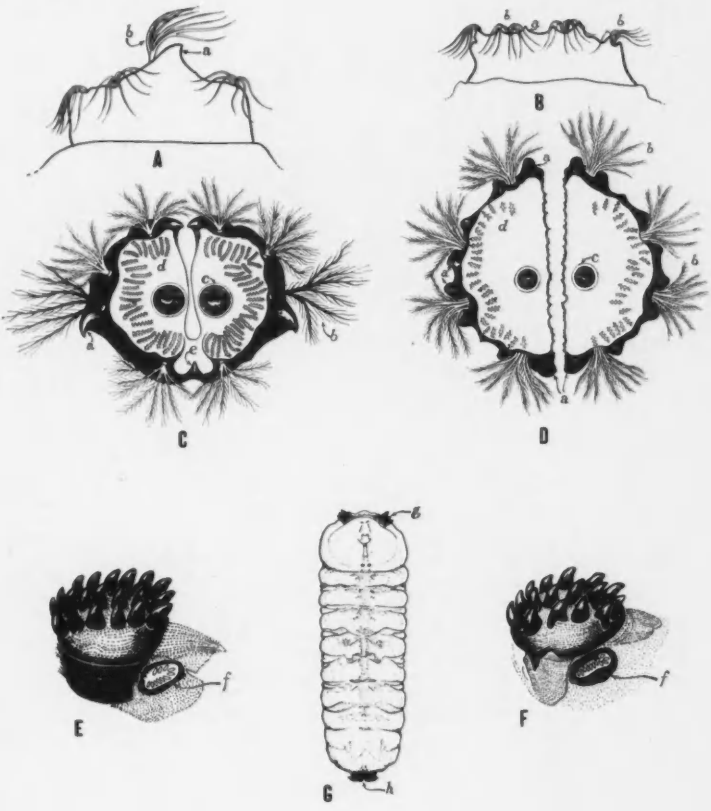
PLATE II.

Fig. A. Male of *Temnostoma bombylans* Fab. Note the shape of the first yellow cross-band on the abdomen, the absence of longitudinal yellow spots above the base of the wings and the dark terminal segments of mid and hind tarsi.

Fig. B. Pieces of decaying hard maple showing galleries made by Temnostoma larvae.

Fig. C. Some of the galleries split lengthwise to show the clean tunnels made by the larvae.

Fig. D. End of a puparium *in situ* in a block of wood, showing the larval thoracic rakes (*r*), the larval prothoracic spiracles (*s*), and the rounded, polished, pupal respiratory cornua (*t*).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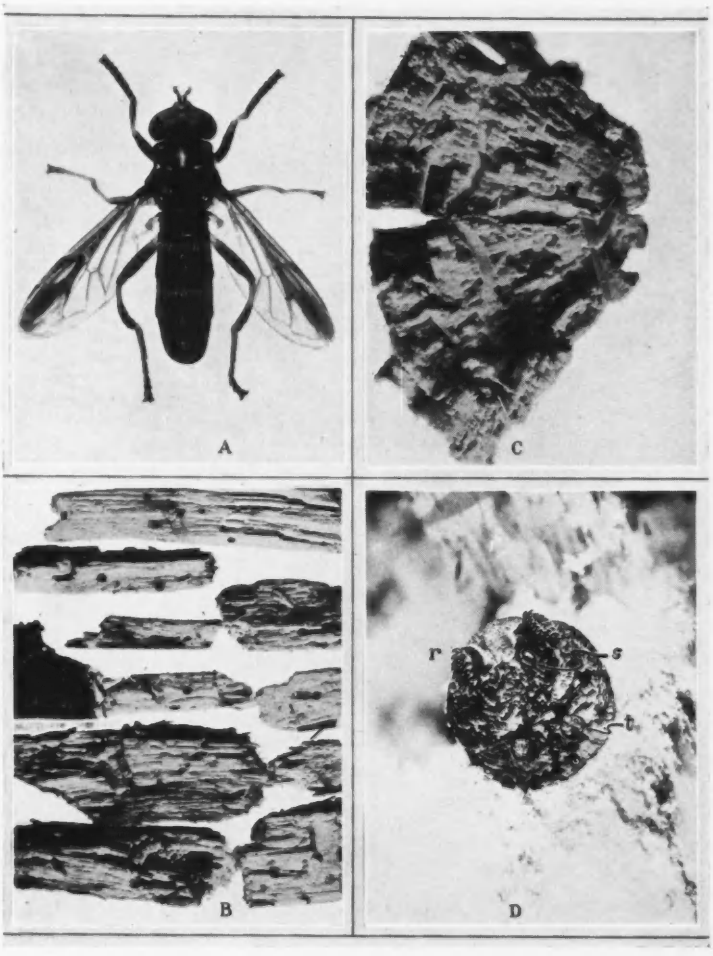
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DISTRIBUTION OF AËDES (TAENIORHYNCHUS) TAENIORHYNCHUS (WIEDEMANN).

AËDES (TAENIORHYNCHUS) JACOBINAE, NEW SPECIES.[1]

JOSE SERAFIM, JR., AND NELSON C. DAVIS,
From the Yellow Fever Laboratory of the Rockefeller Foundation at Bahia, Brazil.

In January, 1930, Shannon and Davis (1) found *Aëdes taeniorhynchus* at Bomfim, in the interior of the State of Bahia, Brazil. This locality is fully 300 kilometers from the seacoast. It was thought at the time that the species might be breeding in certain ponds in the neighborhood. These ponds were said by nearby inhabitants to contain salty water. One that was examined rather thoroughly lay in a depression and was without outlet when the water was low. Seepage water at the margins undoubtedly leeched from the surrounding soil considerable amounts of mineral salts; the sodium chloride content, if any, was not determined. No larvae of *Aë. taeniorhynchus* were found at the time, although adults of this species were taken in the evening with animal bait.

In December, 1931, the species was found at Campo Formoso, very near to Bomfim, and in January, 1932, at Jacobina, about 100 kilometers south of Bomfim and at a similar distance from the seacoast. In Jacobina, larval foci were discovered in clay pits at an abandoned brickyard, and in hoofprints on a nearby road.

The larval and adult characteristics, including those of the male hypopygia, of these specimens from the interior of the state appear to be indistinguishable from those of samples secured at Sao Salvador and at other points along the seacoast.

Dyar (2) makes the following statement: "The larvae [of *Aë. taeniorhynchus*] occur in the coastal marshes in pools while not necessarily salt are not far removed from the coast." In the State of Bahia, Brazil, at least, the species has become

[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of the Rockefeller Foundation.

adapted to a very different environment. All three of the localities where specimens have been secured are situated in a mountainous region. The altitude of Bomfim is said to be 549 meters; that of Campo Formoso, 554 meters; and that of Jacobina, 450 meters.

In December, 1931, there was found in Jacobina a species of *Aëdes* which seems to be still undescribed. Breeding occurred in rock pools along the bed of a small stream, the Rio de Ouro, flowing through the center of town. In the last half of January, 1932, it had been replaced in these breeding places by *Aëdes* (*Taeniorhynchus*) *fluviatilis* (Lutz). However, one adult of the new species was taken with animal bait in the evening of January 22, and another the next evening; no *Aë. fluviatilis* was captured on these occasions, although *Aë. taeniorhynchus* appeared in considerable numbers.

Aëdes (Taeniorhynchus) jacobinae n. sp.

Female: Proboscis long, slender, almost black (color somewhat lighter at tip). Occiput with curved white scales on vertex; long, black, forked scales, concentrated into more or less definite lateral spots, emerging from among the white scales. Mesonotum clothed predominantly with dark brown scales, scantily interspersed with white ones. The latter are noted in an inconspicuous, broken fringe to the mesonotum and in small patches dorsally; these patches usually consist of a few white scales only and occur on the posterior half of the mesonotum, two in the mid-line just anterior to the scutellum and two or more on each side extending somewhat further forward. Median lobe of the scutellum with a clump of white scales. A few fairly broad, silvery white scales on pleurae and coxae. Abdomen dark brown with bronze reflection dorsally; segments with basal white rings; latter narrow to medium width, frequently slightly wider laterally. Basal white rings conspicuous on venter, expanding on posterior segments to wide median patches. Legs dark brown with no white markings. Wings light brown in color; wing scales narrow.

Male: Coloration of the female. Palps about four-fifths as long as proboscis; unmarked. Hypopygium: side-piece long, moderately stout; basal lobe a rather small, but sharply projecting, cone about one-third the length of side-piece from base, clothed with six to eight long setae and with other lesser hairs. Clasper swollen in basal half; terminal filament long and slender. Basal segment of claspette remarkably long, clothed with fine hairs and one strong seta at juncture of middle and outer thirds; terminal filament a blade, broadest at point of articulation, with two points or barbs, one much longer than the other. (This filament resembles the terminal barbs of the claspette of *Aë. taeniorhynchus*, but it is articulated directly with the basal segment,

without an intermediate fused stem.) Tenth sternite heavily chitinized on outer margin and tip; latter swollen, with one freely projecting, well-developed tooth and another recurved point of chitinization attached to the membranaceous portion. Ninth tergites small, quadrate, with six to eight short, but fairly strong, setae.

Larva: Unknown.

Type locality: Jacobina, State of Bahia, Brazil.

Description based on twenty specimens, all from Jacobina. Male holotype and female allotype to be deposited in the United States National Museum.

DISCUSSION.

The classification of this mosquito rests largely on the structure of the male hypopygium. The side-piece has only one lobe, the basal; the claspette consists of a columnar stem, topped by a filament. This would seem to place the species in the subgenus *Taeniorhynchus*, according to Dyar's classification (2). The detailed structure of the claspette is different from that of a close relative, *Ae.* (*T.*) *taeniorhynchus*. The absence of rings on the legs separates the species from all others of the subgenus. The specimens at hand average smaller in size than those of *taeniorhynchus* or *fluviatilis* from the same region.

Peryassú (3) included in the genus *Danielsia* three Brazilian species; namely, *D. mediomaculata* Theo., *D. tripunctata* Theo., and *D. nigrescens* Theo. The first two have been considered by Dyar (2) synonymous with *Aëdes fluviatilis*, and *nigrescens* has been relegated to the genus *Culex*, subgenus *Mochlostyrax* (?). It occurred to us that the species here described as *jacobinae* might be the long-lost *nigrescens*. However, in the description given by Peryassú, *nigrescens* is credited with no white scales on the mesonotum; mention is made that paler brown scales may occur just anterior to the scutellum. Furthermore, the abdominal segments are described as having small basal and lateral spots; *jacobinae* has unmistakable basal rings.

Davis and Shannon (1) showed that both *Aë. taeniorhynchus* and *Aë. fluviatilis* are capable of transmitting yellow fever virus under laboratory conditions. *Aëdes jacobinae* belongs to the same subgenus, and consequently should be regarded with suspicion. In the type locality, breeding occurred within the town limits. It is probable, however, that this was an exceptional situation; ordinarily streams with favorable rockholes

are not found so close to populous communities. Further observations are necessary to determine the blood-feeding habits and the range of distribution of the species.

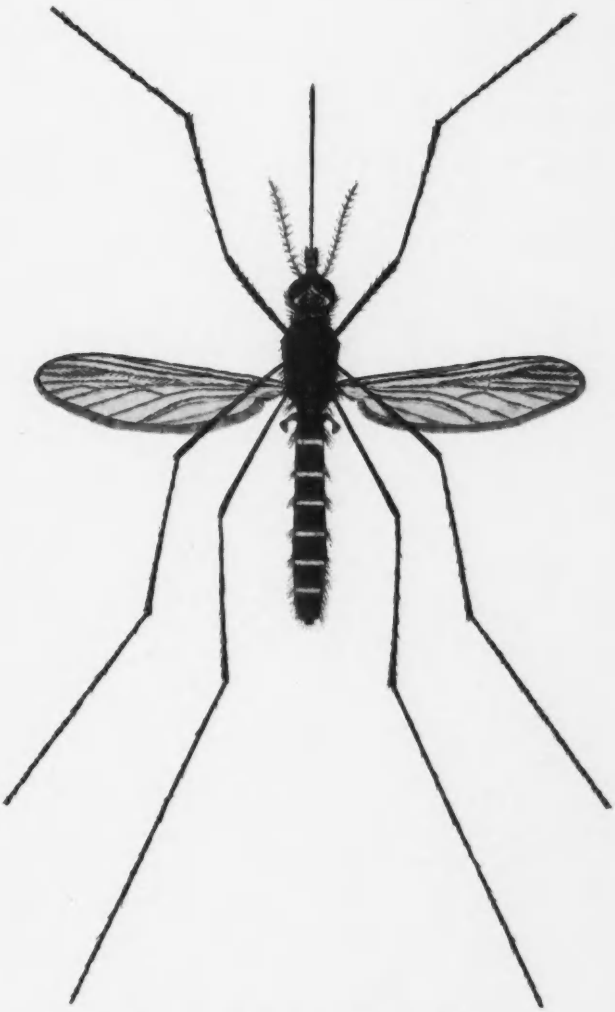
SUMMARY.

1. *Aëdes* (*Taeniorhynchus*) *taeniorhynchus*, which is usually considered a coastal species, has invaded the interior of the State of Bahia, Brazil, to points at least 300 kilometers from the seacoast.

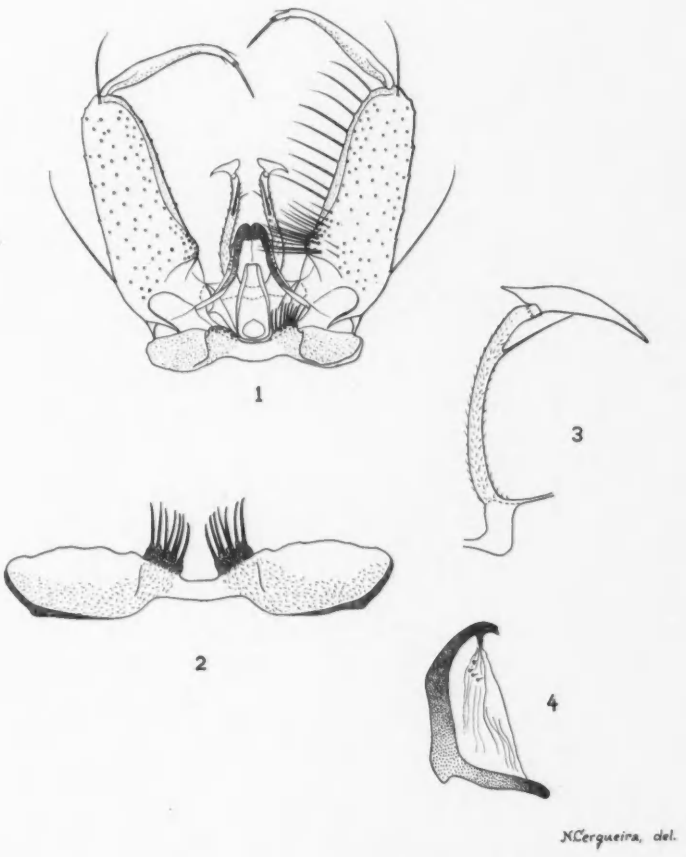
2. *Aëdes jacobinae*, new species, is described. The structure of the hypopygium indicates that this mosquito belongs to the subgenus *Taeniorhynchus*. The absence of leg markings distinguishes it from all closely related species.

REFERENCES.

(1) **Davis, Nelson C.** and **Shannon, Raymond C.** 1931. Amer. Jour. Trop. Med., 11, No. 1, 21.
(2) **Dyar, Harrison G.** The Mosquitoes of the Americas. 1928. Carnegie Institution of Washington.
(3) **Peryassu, Antonio G.** Os Culicideos do Brazil. Rio de Janeiro, 1908.



Female *Aëdes jacobinae* sp. nov. × 10.



Details of male hypopygium of *Aëdes jacobinae*.

Fig. 1. Entire hypopygium × *circa* 90.
Fig. 2. Ninth tergite × *circa* 180.
Fig. 3. Claspette × *circa* 160.
Fig. 4. Tenth sternite × *circa* 160.

EULOPHUS VIRIDULUS THOMS., A PARASITE OF PYRAUSTA NUBILALIS HUBN.

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In the search for parasites of the European corn borer, upon which the writers have been engaged for some years, it quite often happens that a specimen or two of a rare parasite is occasionally found. More extensive and scrupulous searching in connection with preliminary meteorological studies, a chance encounter, or else an observation by another person, may lead to the discovery of a locality where the parasite in question exists in numbers sufficient to constitute a factor in the local control of the host and to permit of collection on a comparatively large scale. Such has been the case during the last six years, with *Phaeogenes nigridens* Wesm., *Apanteles thompsoni* Lyle, *Chelonus annulipes* Wesm., and, lately, this has been true of *Eulophus viridulus* Thoms., owing principally to the observations of Dr. Athos Goidanich(*4*).[1]

IDENTITY OF THE SPECIES.

Eulophus viridulus, for which no host records have been found in the literature prior to 1928, was first cited (*1*, p. 137; *12*, p. 37–38) as a parasite of *P. nubilalis* under the name of *Eulophus* sp., and was later mentioned (*8*) as *Hemiptarsenus unguicellus* Zett. This latter determination was found to be an error.

In 1928 Ellinger and Sachtleben (*2*, p. 109) published a report on the parasites of the European corn borer in central Europe, and a certain similarity was noted between their colored Figures 8 and 9 on Plate II and specimens in the collection at Hyères. A closer study of the drawings and descriptions, however, failed to permit us to identify our species as *E. viridulus*, and it was not until Dr. Sachtleben kindly supplied us with some specimens bred by him that we became

[1]Italic numbers in parentheses refer to Literature Cited.

convinced[2] that our species is the same as that treated by Ellinger and Sachtleben, viz., *Eulophus viridulus* Thoms.

However, in order to shed all possible light on the probable identity and host relations of this species, the following note received from Dr. Masi is interesting:

"In our collection there are examples of *Eulophus* parasites of *Lithocolletis* in Italy which vary considerably in coloration. Some examples resemble the Pyrausta parasite, but I dare not affirm definitely that they are the same species. If it is so, as I believe, the name of *E. viridulus* would fall into synonymy under that of *E. rivillellae* Rondani which was given (*9*, Pl. 9, 17) one year before Thompson's publication."

GEOGRAPHICAL DISTRIBUTION OF EULOPHUS AND COLLECTING OPERATIONS.

Described originally from Sweden, the first record of this parasite being associated with *P. nubilalis* was made by Prof. F. Silvestri,[3] who reared two specimens from this host taken in hemp at S. Vitaliano near Portici, Italy, in 1919. It was next found by the writers in Pyrausta tunnels in *Artemisia* near Bezons on the outskirts of Paris in March and again in August, 1923. Another colony was collected in *Polygonum* near Paris, in September, 1924. In March, 1925, two colonies were found in corn on the Mediterranean Coast. Dr. A. Ogloblin bred a colony of this species from *P. nubilalis* from corn in V. Sevejut, Czechoslovakia, in September, 1927.

Later, Goidanich (*4*) cites this parasite (calling it *Eulophus* n. sp.?) as being very common in the region of Bologna, Italy, in hemp.

In addition Ellinger and Sachtleben (*2*, p. 126; *10*, *11*) list this parasite in their reports from Peremarton, Hungary; Trojan, northern Bulgaria; Merisan, Rumania; and Keszthely, Hungary.

In volume II, page 120, of the same work B. Hergula (*6*) lists *E. viridulus* from the following localities in northern Yugoslavia: Kraljevec, Petrinja, Bjelovar, and Virovitica. He gives figures on the percentages of parasitism, which vary from 0.3 at Bjelovar to 2.0 per cent at Petrinja.

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[2]In this matter and in the description of the adult, we are grateful to A. B. Gahan, of Washington, Dr. Luigi Masi, of Genoa, and Svetoslav Novitzky, of Torun, Poland, for their able assistance. Mr. Novitzky believes this species to be distinct from that bred by Ellinger and Sachtleben.

[3]Private communication.

Filipjev (*3*, p. 169) reports having reared a species of *Eulophus* from *Pyrausta* larvae at Azerbeijan, Russia.

In 1929 the writers, accompanied by Mr. Goidanich, made a survey in the region of Bologna, Ferrara, and Mantova, Italy, where a number of colonies were found in a single locality.[4] The following winter a single colony was collected near Correzzola in the Province of Padua.

Finally a large-scale collection was made in hemp at Castelnovobariano (now Castelmassa) in late July and early August, 1930, when over five hundred colonies of this parasite were found. These colonies gave a total of 2,759 larvae and pupae for shipment to the United States in addition to a certain number preserved for studies and others not in condition to withstand shipment.

Further operations in corn in the same locality in late September gave 64 more colonies, from which 514 individuals in the late larval, pupal, or adult stage were selected for shipment and colonization. At the same time the remaining cornstalks in the above-mentioned field were set aside for winter collecting purposes.

On November 4 the writers started collecting work in the above-mentioned stalks and by November 15 had procured 11,150 pupae. From these pupae 34 males and 32 females had emerged by November 20, thus demonstrating that the individuals do not all go into the overwintering diapause simultaneously. It is unlikely that adults emerging at this time of the year, if indeed they do emerge under field conditions, would continue breeding activities.

It is pointed out that this parasite was found in August, 1930, in a single hemp field within 200 yards of the exact spot in which it was found in 1929. Extensive collections (at this time of the year) in nearby fields of hemp, corn, and sorghum failed to reveal the presence of *Eulophus* save in a cornfield within 100 yards of the heavily infested hemp field, where one colony was noted.

During the winter, however (from December 1 to April 1), extensive collecting operations were carried on in this region and over 300,000 corn borer larvae were collected. Pupae to the number of 328,026, representing 14,078 colonies of *Eulophus*,

[4]On the farm at Castelnovobariano (Province of Mantua) of Sig. Panzacchi, to whom the writers are grateful for his hearty cooperation and aid.

were found. The distribution of the parasite was confined to a region northeast of Castelnovobariano (near Massa) and extending for several kilometers in that direction into the low semi-marshy lands. On the other (right) bank of the Po River at stations only a few kilometers away a million corn borer larvae were collected but not a single colony of *Eulophus* was found.

One colony was found in the plains of Friuli near St. Giorgio di Nogaro (Udine) during the winter.

DESCRIPTION OF EULOPHUS VIRIDULUS THOMS.

The adult was first described by C. G. Thomson (*13*, p. 233) in 1878. The following description was made to include details which Thomson's rather summary description did not mention.

General: Female.—Thorax prominently robust, wings hyaline, submarginal vein entire, and shorter than the marginal vein, in proportion 10:9; stigmal vein distinct, postmarginal vein over twice as long as stigmal vein (radius); parapsidal furrows distinct anteriorly, practically effaced posteriorly. Hind tibiae with two apical spurs, tarsi 4-jointed. Scutellum without dorsal grooved lines. Antennae inserted slightly below middle of face; flagellum cylindrical; antennae appearing to be seven-jointed but actually consisting of scape, pedicel, two ring joints (extremely thin and visible only under very high power), a four-jointed funicle, and a club consisting of three joints which have the appearance of being fused.

The male characters are similar except for the three long, hairy branches on the first three funicle joints. Eyes nearly naked; head from in front somewhat narrowed below, ocelli forming wide triangle, the scape not reaching farther than the hind margin of the first ocellus; no notch in the middle of the clypeus; abdomen almost sessile, pointed at apex.

Color and Sculpture: Female.—Antennae black, the ventral part of scape light lemon yellow, flagellum covered with short grayish hairs; head metallic green in front, almost black behind, finely but distinctly reticulated in front, reticulations almost absent behind, the whole sparsely and shallowly punctate, with short grayish hairs in the punctures. Prothorax almost black, finely reticulated; rest of thorax brassy-green; prescutum deeply and finely reticulated in front, more deeply and coarsely so posteriorly; scapulae similar in reticulation to forward part of prescutum; axillae and scutellum evenly and somewhat coarsely reticulated, central part of scutellum more finely so; propodeum coarsely reticulated, with some irregular longitudinal rugosities near the anterior border and sometimes with a quite distinct median carina; spiracles round; lateral folds absent; spiracular grooves shallow, but distinct; area laterad of these grooves with a few grayish hairs, puncta-

tion of this area as well as that immediately around spiracles finer than on posterior part of prescutum. Abdomen viewed from above flat, lanceolate in form, dorsum variable in color, often almost entirely bronzy-black with more or less faint yellowish blotches near the lateral margins, but sometimes largely yellowish above with only the margins and the area down the middle dark; beneath always yellowish; last segment thickly, other segments sparsely covered with hairs; ovipositor extending very slightly beyond apex of abdomen.

The legs and feet are pale lemon-yellow except that in some cases the coxae are all metallic, while in other specimens they are mostly yellowish with a greenish spot externally; the hind coxae are coarsely punctate externally and bear internally near their posterior border a diagonal row of four hairs on black bases.

Male.—Color and sculpture of thorax similar to that of female, reticulations slightly more regular and not so deep; abdomen spatulate, with a rather wide transverse white band just back of the second segment; last tarsal joints fuscous.

Egg.—The egg (Pl. I, Fig. 7) is of a whitish color, oblong ovate in form, slightly larger at one end than at the other, and without spines or tubercles.

Larva: Instar I.—(Pl. II, Fig. 10). Length, 0.25 mm.; length of mandible, 0.012 mm. The newly hatched larva is more or less cylindrical in form, composed of a head and 13 distinct body segments, whitish in color and without epithelial spines or tubercles except two pairs of tiny papillae on the tenth abdominal segment.

The head (Pl. II, Fig. 11) is almost spherical in form, slightly flattened ventrally; it is of a whitish color and not very heavily chitinized; dorsally it bears a pair of antennal rudiments (Pl. II, Fig. 11, *ant*), each bearing a pair of tiny sensory papillae; ventrally is the mouth-opening (*m*) and within the mouth is a pair of rather fine, simple, slightly curved mandibles; below the mouth a pair of sensory organs represent the maxillary palpi; near the posterior ventral border a fold in the skin extends across the lower part of the head between the hypostomata; the tentorium extends well into the prothorax. The internal anatomy is without special interest. The tracheal system is composed of the usual lateral longitudinal trunks joined anteriorly and posteriorly by the transverse commissure, and there are four pairs of open spiracles, one pair situated on the second thoracic and one each on the first three abdominal segments.

Instar II. Length, 0.59 mm.; length of mandible, 0.018 mm.; diameter of thoracic spiracle, 0.014 mm. Similar to Stage I except that the abdomen is more distended and somewhat less cylindrical and the mandibles are more triangular in outline, while there are nine pairs of open spiracles.

Instar III. (Pl. II, Fig. 12). Length, 2 mm.; length of mandible, 0.04 mm.; diameter of thoracic spiracle, 0.0185 mm. Similar in form to Stage II. The head is roughly hemispherical, with a pair of rather prominent single-jointed antennae and with ten pairs of sensorial

papillae around the mouth.[5] The body is without spines or setae[6] except for the two pairs of papillae on the tenth abdominal segment. The internal anatomy is much the same as that already described for other chalcids. A point worthy of notice, however, is in the arrangement of the muscular system. As will be seen by the diagram, the last two thoracic and the abdominal segments have *three* diagonal muscles each (Pl. II, Fig. 14, *d*) extending ventrally and anteriorly, instead of two. Previously no eulophid was known to possess this arrangement, which was believed to be restricted to the Pteromalidae (*7*, p. 324).

Another point worth mentioning is the fact that in the fully grown larva the anterior ends of the lateral Malpighian tubes have a chalky appearance as if filled with a milky excretion; this can be seen through the integument.

Pupa.—The pupa (Pl. I, Fig. 6) is of the typical naked chalcid type. In the summer generations some pupae are covered by a thick black skin and some are covered by a thin brownish skin, while in the overwintering generation, so far as has been observed, all pupae are of the black, thick-skinned sort.

The male pupa may be distinguished from the female by the following characters:

Female.—Antennae not reaching quite to distal end of first legs, pedicel and ring-joints larger than in male.

Male.—Antennae extending to or beyond distal end of first legs, pedicel and ring-joints not pronounced enlargements, last legs extending farther caudad than in female.

EMERGENCE.

When the adult is ready to issue, the pupal skin breaks transversely at the neck and splits longitudinally along the median dorsal line for a short distance. The adult squirms out of this shell, leaving it more or less intact. When out, the body is entirely free from the prothorax posteriorly, but the head and antennae are still covered with the pupal skin. This is scraped off with the front legs and the adult is then entirely free.

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[5]Dr. A. Goidanich (*5*, p. 166) in describing the head of the *Eulophus* larva shows a sort of lateral suture setting off a pleural area in which is a large sensorial organ.

This is erroneous; no such suture exists in chalcid larvae; the organ in question is represented by *th* in our Figure 13 (Pl. II), and is either a thickening of the chitin where certain of the tentorial structures join the head capsule or else it represents the rudimentary eye.

[6]Sachtleben (*11*) figures the larva of this species with tiny lateral papillae or tegumentary spines. The writers find no such spines.

HABITS OF THE ADULT.

The adults are rather strong fliers as compared with many chalcids. When being handled in the laboratory they will often fly away rapidly towards the source of light.

The adults were given food consisting of sugar water and honey water. They were not observed to feed upon the blood of the host.

Oogenesis seems to take place rather slowly and in no case has a large number of developed eggs been found in the females dissected for study, even though some of these dissections were made upon well-fed individuals several weeks old.

The males are quite active sexually and copulation is obtained easily with newly emerged adults. The male approaches the female and shows his interest by flipping the wings. He then mounts upon the thorax of the female, his front legs resting on her thorax, his hind legs on her wings; the middle pair wave back and forth horizontally, now together, now alternately, wings raised, antennae vibrating and occasionally stroking those of the female on their outside. The male then literally "sets back on his haunches," the body straight up, the end of his abdomen touching the upper surface of the female's wings at a point just above the tip of her abdomen. The female remains motionless, wings folded, legs in their natural position, antennae pointing up; the male rests in this position from 3 to 15 seconds. He then shifts forward again bringing his body horizontal to that of the female and repeats the above mentioned exercises, backing up in the usual way. Some males even go so far as to back completely off the female, seemingly waiting there for her to raise the wings thus better to allow copulation. For some time (2 to 8 minutes) this continues, the motions become more violent, the antennal-stroking more vigorous and occurring with greater frequency, the waiting period between these stroking movements is diminished, and the abdomen is curved upward in a jerky motion at intervals corresponding with the antennal strokes.

Finally the female raises the tip of her abdomen and at the same time lowers the sclerites around the genital opening, the male moved backwards and slightly to one side and bringing his abdomen to an inverted horizontal position pushes its tip far forward and copulates for 3 to 5 seconds.

It is probable that in nature the males, which issue first, fertilize the females before leaving the host tunnels, thus permitting few if any unfertilized females to occur under natural conditions.

Longevity: In our experiments on 14 females, which were well fed and cared for, the average length of life was 27.4 days and the maximum 75 days. Females without food lived for as long as 14 days when kept in a cool room. Males furnished with food may live two weeks or more.

The writers have not witnessed the act of oviposition. In a large number of experiments, performed with a hundred or more females under all sorts of conditions, oviposition occurred but twice and then it was unobserved. In one other case a female was found beside a paralyzed larva in a stem of hemp and it seemed probable from the marks on the body of the larva that she had stung it into a state of paralysis. From observations on parasitized larvae found in the field it can be said that the female always paralyzes the host larva and then lays the eggs on the outside, placing them more or less indiscriminately on the host's body. The eggs are not attached to the host in any way. It is not necessary that the host be paralyzed by the adult's sting in order for the parasite larvae successfully to feed and mature upon it. Young larvae have been transferred to fifth-stage hosts killed by coddling in hot water and have fed thereon to maturity and transformed to adults.

The parasite may attack stages III, IV, and V (last) of the host larva. Stage III is less attacked than IV, and IV slightly less than V. Generally, the larvae are attacked in the tops of the hemp stalks, as no colonies were found in the lower parts, though many host larvae were collected from these portions of the stalks.

LARVAL HABITS AND PUPATION.

The young larvae wander little, if any, from the hatching points, but start their external feeding at once. They grow rapidly and within 4 to 5 days reduce the host to an empty skin. They then disperse, some crawling away to a distance of 2 or more inches, and pupate. To pupate, the larva rests with its dorsum against the supporting surface, and evacuates the larval "meconium" in a series of soft little blackish balls

which remain grouped near the caudal end of the larva. The last larval skin is then shed and sticks to the wall of the tunnel and to the caudal extremity of the pupa, thus attaching the latter more or less securely to the wall of the host tunnel.

SIZE OF COLONY AND PROPORTION OF SEXES.

From a study of 471 colonies of the summer generation in hemp, the average size of a summer colony is fixed at 7.6 individuals.

The fall and winter colony in corn is, however, considerably larger. A total of 558 colonies examined for this point in November gave 9,242 individuals, or an average of 16.5, while the 14,078 winter colonies averaged 23.3 individuals per colony.

Many colonies containing only two or three individuals were found. The largest colony found contained 57 individuals, but this was evidently a case of two or more colonies on the same host larva, as there were 3 eggs and 17 stage I, 18 stage II, and 19 stage III larvae present. The largest homogeneous colony found contained 35, evidently the result of a single oviposition, as all the individuals were in the same stage of development. Colonies of 20 to 28 individuals were frequently found.

In regard to the proportion of sexes, our data, while somewhat meagre, are sufficient to show that the females predominate. From a study of 22 complete colonies which gave 50 males and 109 females, and a miscellaneous lot of adults reared from field-collected material, in which were about 20 males and 65 females, it is apparent that the females predominate in the ratio of about 2 to 1. D. W. Jones informs the writers that in a lot of adults reared from the material shipped to the United States there were 226 males and 410 females. Many colonies contained only females, but usually both sexes were present. In one instance a colony composed of 15 larvae gave eight adult males, the other seven dying; no other case of a colony containing only males has been observed.

SEASONAL HISTORY OF HOST.

So much has been said and written of the seasonal history of *Pyrausta nubilalis* that it is hardly necessary for the writers to go into details concerning this insect. We shall give briefly

the salient facts of the biology of *Pyrausta* in so far as they are concerned with the biology of *Eulophus*.

In the Padovian (South) Zone (Provinces of Rovigo, Mantua, Ferrara, etc.), where *Eulophus* has been studied, *Pyrausta nubilalis* occurs abundantly in corn and hemp, and occasionally in smartweed, cocklebur, pigweed, and sorghum. It has two generations in this region, the larval period of the first generation being, in a general way, from early July to the middle of August, and that of the second generation from August 15 until the following May, with the larvae of this generation reaching maturity about September 15.

The eggs are laid on the undersides of the leaves and the young larvae upon hatching start to feed near the top of the plant and later, upon maturing, or slightly before, migrate downward, infesting the middle and lower portions of the stalks.

The corn planted in this region is principally of two distinct varieties, viz.: Agostino, an early-maturing white corn, and Cinquantino, a later, rapidly-maturing yellow corn. The first generation of the host occurs only in the Agostino variety of corn and in hemp; the second occurs in both varieties, in the seed hemp, and in the other plants enumerated above.

The hemp is usually of a uniform age and is cut and dried about August 15 (except the fields planted for seed hemp, in which the female plants are left standing).

Pyrausta overwinters principally in the cornstalks, probably slightly in the weeds, and not at all in the hemp for the reason that the larvae perish in the fiber-making process and the stalks of the seed-bearing plants not used for fiber are usually burned. Such larvae as commence a second generation in hemp are therefore destroyed before or during early winter. The cornstalks, on the contrary, are carefully gathered and stored either in barns or outdoor stacks for winter bedding.

The other zones where this chalcid has been found are: Mediterranean (South) and the Plavisian (Friuli), where there are two host generations in corn; the Danubian, where there is one generation in corn; in the mountainous regions of Northern Yugoslavia where there is probably but one generation in corn; the Sequanian (South), where there is one generation in *Artemisia;* the Campanian, where there are two generations, at least, in corn, and probably only one complete in hemp, as in the Padovian (South) Zone.

SEASONAL HISTORY OF THE PARASITE.

Eulophus passes the winter in the pupal stage in the host tunnels.

Hibernation seems to be a true diapause, as the writers have performed experiments on pupae in the fall and throughout the winter in an effort to force emergence. This, it would seem, can be obtained only after a long rest period. Pupae were placed at 5°, 18°. and 25° C. in October and no adults issued before March. Those exposed to high temperatures emerged slightly before those exposed to low temperatures. No special provisions were made to supply moisture to these pupae, and for a time they were simply in vials in the laboratory. This fact may account for the rather high mortality, as out of a total of 23 only about a third eventually produced adults.

The pupae collected in winter or early spring gave adults under laboratory conditions in March. It is probable that in nature the spring emergence occurs in late April or May. If this be so, the adults could very easily wait around until the earliest borer larvae appeared, in order to deposit their eggs. It is not improbable that there are one or more intermediate hosts.

The summer observations in 1930 can probably be taken as indicative of the general trend of this parasite's seasonal activities.

On July 12, in hemp, three colonies were taken, two of which were in stage I and one of which was in the prepupal stage. No further colonies were found from this date on until July 21, when 20 colonies were collected, 5 being in the egg or young larval stage, 9 in the full-grown larval or prepupal stage, and 6 in the pupal stage. From this date on, the larval colonies became less and less abundant, and the pupal colonies more so. On July 25 the first adults emerged; and on August 2, of 114 colonies 12 had emerged, 87 were in the pupal stage, 12 were mature larvae, and one was a stage I larva, showing that adult emergence was well under way and that oviposition by the recently emerged females had commenced, thus starting the second generation of parasites on the first-generation host larvae in the same hemp fields. On August 5 and 6, four other colonies in the egg and first larval stage were found, further confirming this hypothesis. Five other colonies were in the full-grown larval stage, while nine empty skins and 31

pupal colonies were taken; adults were emerging rapidly from the pupae. It is probable that the peak of adult emergence occurs about August 10 to 15.

At this point, owing to hemp-cutting operations, observations and collections were interrupted. They were later resumed in seed hemp and weeds in the vicinity but no *Eulophus* were found. Later, as the larvae of the second generation began to mature, these observations were continued without results, but others made in cornfields near by revealed that *Pyrausta* was present in considerable numbers and *Eulophus* fairly abundant in both the dry Agostino and the fresh Cinquantino varieties of corn. In the Agostino or earlier corn there were traces of a first-generation colony of *Eulophus*.

From September 10 to 16, 25 colonies were found, of which 6 had already issued as adults and 19 were in the larval and pupal stages. By September 24 five others of the remaining 19 had issued and all larvae had transformed to pupae.

From September 17 to 26 a lot of 41 colonies was found, of which 21 were in the larval stage, 19 in the pupal, and 1 issuing as adults. Four were still in the full-grown larval stage and the rest were in the pupal stage. This observation seems to indicate a slowing up in the adult emergence and it is possible that some of the pupae which were formed at this time pass the winter and emerge the next year. On November 5 and 6, among 143 colonies composed of about 2,400 individuals collected, two colonies were in the last larval stage, several were empty, and the rest were in the pupal stage.

Thus it is seen that while a small proportion of the colonies parasitizing the second generation of *Pyrausta* in corn issue as adults in the fall and deposit eggs, the majority remain in the stalks as overwintering pupae.

It is further pointed out that in the case of *Eulophus* there is a definite migration of the parasites from hemp in the summer generations to corn in the fall and overwintering generations.

In the Sequanian (South) Zone five colonies of this parasite in the pupal stage were found in *Artemisia* near the bridge at Bezons, Seine, from March 1 to 17, 1922. Adults from these pupae started issuing on April 20 in the laboratory and continued doing so until May 8, some females living until June 21.

Two colonies of almost mature larvae were found on stage III host larvae in *Artemisia* in the same locality on August 8, 1923.

These larvae pupated on August 10, forming light brown pupae from which the adults issued on August 21. In the same zone a colony of 17 larvae was found in *Polygonum* on September 24. Judging from the above indications it seems probable that there are two generations of this parasite in the Sequanian Zone also.

In Czechoslovakia Dr. A. Ogloblin reared a colony of this parasite to the adult stage on September 16, 1927.

A few other records made by the writers substantiate the foregoing observations and conclusions. For instance, in 1929 the writers found a colony of feeding larvae in corn near Correzzola (Padua), which pupated on October 24 and passed the winter without change.

LENGTH OF THE LIFE CYCLE.

From field observations it seems that in July and August the period from egg to adult of this parasite is about 14 days. Several colonies taken in the egg or early larval stage were followed through to the adult stage. From hatching to pupation required 5 days, and from pupation to emergence 7 to 9 days.

EULOPHUS AS A CONTROLLING FACTOR OF P. NUBILALIS.

Parasitism (Table I) by this species for the first generation in 1930 in the vicinity of Sermide is based on figures obtained from large collections in two hemp fields about a kilometer apart. In the second generation the data are taken from collections in corn, as no *Eulophus* were found in the remaining (seed) hemp.

The individual fields examined consisted of (1) a hemp field (Fig. 16) of about one-half acre, (2) another field of about the same size located about a kilometer from (1); (3) a field of early maturing Agostino corn about 160 meters from (2); (4) another field of early maturing corn about 500 meters from (2); (5) a field of late Cinquantino about 700 meters from (2).

Gross winter collections for the whole region of Castelnovobariano (322,000 host larvae) showed a parasitism of about 4 per cent, while the total for the whole South Padovian Zone is only about 1 per cent.

Other fields of corn and hemp were studied throughout the lower Po Valley and, except as stated, no colonies of *Eulophus* were found.

TABLE I.

Population of *Pyrausta nubilalis* and of its Parasite, *Eulophus viridulus*, in Five Fields Near Castelnovobariano, Italy, in 1930.

Field No.	Estimated Number of Plants per Hectare	Per cent of Infestation by Pyrausta	Calculated Number of Infested Plants per Hectare	Number of Pyrausta per 1,000 Infested Plants as Found by Dissection	Number of Pyrausta Individuals Present per Hectare	Total Per cent of Parasitism by all Species	Number of Parasitized Pyrausta Present per Hectare	Total Number of Pyrausta Actually Collected in Field	Total Colonies of Eulophus Found	Per cent Parasitism by Eulophus	Total Number of Eulophus Individuals Present per Hectare
FIRST GENERATION, HEMP											
1	1,250,000	20	250,000	554	138,500	7.5	10,387	7,121	0	0	0
2	1,250,000	5	62,500	666	41,625	23.90	9,948	14,358	537	3.7	11,620*
SECOND GENERATION, CORN											
3	40,000	62	24,800	1,580	39,184	10.50	4,114	13,031	558	4.3	26,160
4	40,000	87	34,800	1,215	42,282	25.80	10,909	8,899	122	1.3	9,976
5	40,000	93	37,200	1,178	43,822	7.60	3,331	1,104	34	3.0	21,631

*Average size of summer colony, 7.6 individuals.
Average size of fall colony, 16.5 individuals.
Average size of winter colony, 23.3 individuals.
A hectare is approximately 2.4 acres.

PARASITES AND PREDATORS.

In one colony of *Eulophus* prepupae, four individuals were found to be parasitized by a species of mite. Two specimens bore one mite each and two bore two each. In each case the mites were attached near the anal extremity of the host, and their abdomens were enormously distended. The host was apparently being killed by them. The mites were determined by M. Marc Andre as *Pediculoides ventricosus* Newport.

SUMMARY.

Eulophus viridulus Thoms. is, in the larval stage, a primary parasite of the larva of the European corn borer.

The female paralyzes the corn borer larva with her sting and deposits a number of eggs on it. The larvae feed externally and, after passing through at least three larval stages, pupate on or near the host remains, within the tunnel of the latter.

The average size of the summer colony is 7.6, of the fall colony 16.5, and of the winter colony 23.3 individuals.

The females predominate in the ratio of 2 to 1.

This parasite occurs in corn, hemp, and *Artemisia* and is found in small quantities in central Europe, northern France, southern France, northern Italy, in the lower Po Valley, and southern Italy around Naples. It occurs rather abundantly in only one place and that is a limited region in the lowlands extending northeast several miles from Castelnovobariano on the left bank of the Po River near Massa Superiore in the Province of Rovigo. On the opposite bank of the Po, only a few miles away, the parasite does not occur.

The parasite has at least three generations on the corn borer in the lower Po Valley. The first and second occur in hemp and Agostino corn, on the first brood of the host, while the third (and very probably a partial fourth) occurs in both the Agostino and the Cinquantino corn but upon the second generation of the host.

The winter is passed in the pupal stage in the host tunnels and hibernation would seem to be a true diapause.

Efforts to breed this parasite on a large scale have so far been unsuccessful. Field collections during the winter of 1930–31 yielded a total of 328,026 pupae for colonization in the United States.

Generally speaking, this parasite is of little economic importance in Europe. Nevertheless in the restricted region mentioned above 4 per cent of the total borer population are killed by this species and the density of the parasites was found in four fields to be 9,976, 11,620, 21,631 and 26,160 individuals per hectare.

LITERATURE CITED.

(1) **Caffrey, D. J.** and **Worthley, L. H.** 1927. A progress report on the investigations of the European corn borer. U. S. Dept. Agr. Bul. 1476, 155 p., illus.

(2) **Ellinger, T.** and **Sachtleben, H.** 1928. Notes on the Central European parasites of *Pyrausta nubilalis* Hb. In Internat. Corn Borer Inves., Sci. Rpts., Vol. 1, Internat. Live Stock Expo., p. 109–134, illus. Chicago. (Also Zur Kenntnis der parasiten von Pyrausta nubilalis Hb. aus dem Rhein -und Donaugebiet. Arbeiten aus der Biol. Reischs. fur land -und forstw. 17: [321]–344, illus.).

(3) **Filipjev, I. N.** 1930. [Report of the] Division of Applied Entomology. State Inst. Exper. Agron. Ann. Rpt. 1928–29, p. 169–198. Leningrad. (Rev. Appl. Ent. Ser. A., 18: 606–607.)

(4) **Goidanich, A.** 1928. Contributi alla conoscenza dell' entomofauna della canapa. I. Prospetto generale. Bol. del Lab. di Ent. Inst. Sup. Agr. di Bologna 1: [37]–64.

(5) ———. 1931. Gli predateri e parassiti della *Pyrausta nubilalis* Hubn. Bol. del Lab. di Ent. Inst. Sup. Agr. di Bologna 4: 77–218.

(6) **Hergula, B.** 1929. Insect parasites of the corn borer in northern Jugoslavia. *In* Internat. Corn Borer Inves., Sci. Rpts., Vol. 2, Internat. Live Stock Expo., p. 111–127, illus. Chicago.

(7) **Parker, H. L.** 1924. Recherches sur les formes post-embrionnaires des chalcidiens. Ann. Soc. Ent. de France 93: [261]–379, illus.

(8) **Parker, H. L., et al.** 1929. *Pyrausta nubilalis* Hubn. in Europe: Notes on infestation and parasitism from 1926 to 1928. Jour. Econ. Ent. 22: 688–693.

(9) **Rondani, C.** 1877. Antispila rivillella et ejusdem parassita. Bul. Soc. Ent. Italiana 9: 287–291, illus.

(10) **Sachtleben, H.** 1930. Notes on *Pyrausta nubilalis* Hb. and its parasites in Bulgaria. *In* Internat. Corn Borer Inves., Sci. Rpts., Vol. 3, Internat. Live Stock Expo., p. 42–57, illus. Chicago.

(11) ———. 1930. On the parasites of *Pyrausta nubilalis* Hb. in Hungary. *In* Internat. Corn Borer Inves., Sci. Rpts., Vol. 3, Internat. Live Stock Expo., p. 101–112, illus. Chicago.

(12) **Thompson, W. R.** and **Parker, H. L.** 1928. The European corn borer and its controlling factors in Europe. U. S. Dept. Agr. Tech. Bul. 59, 63 p., illus.

(13) **Thomson, C. G.** 1878. Hymenoptera Scandinaviae. Vol. 5, p. 233. Lundae.

EXPLANATION OF PLATES.

PLATE I.

Eulophus viridulus Thoms.

Fig. 1. (A text figure deleted.)
Fig. 2. Head of female from above.
Fig. 3. Head of female from in front.
Fig. 4. Antenna of female.
Fig. 5. Detail of wing.
Fig. 6. Pupa of female.
Fig. 7. Egg.
Fig. 8. Spiracle of last instar larva.
Fig. 9. Mandible of last instar larva.

PLATE II.

Eulophus viridulus Thoms.

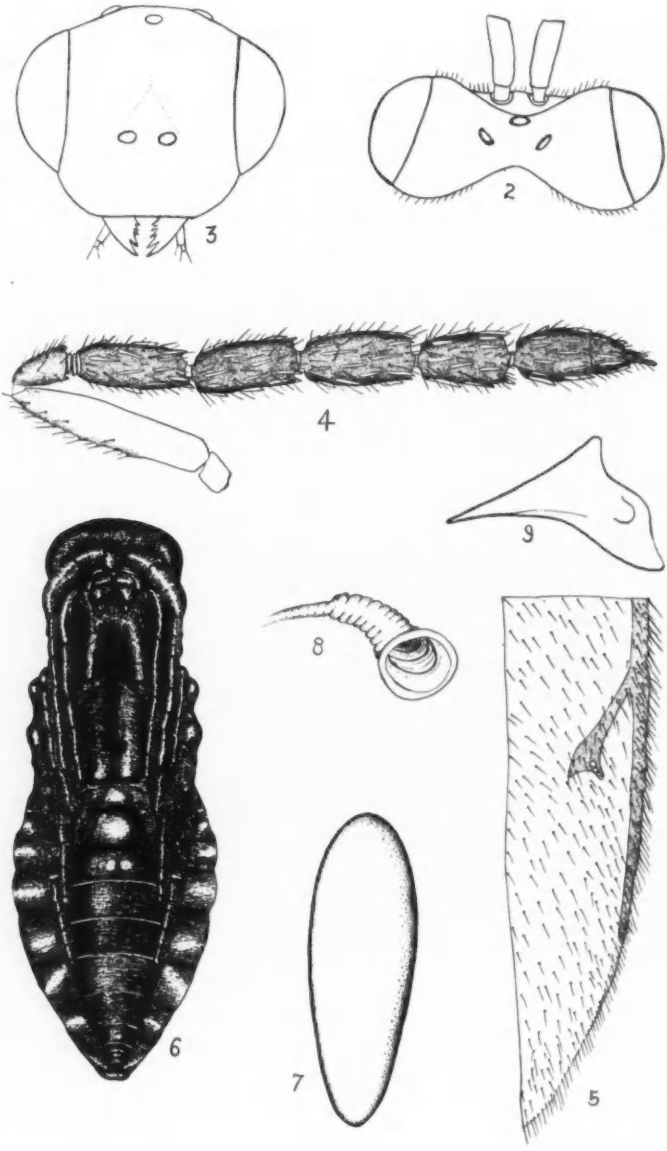
Fig. 10. First instar larva, ventral view.
Fig. 11. First instar larva, head, ventral view.
Fig. 12. Third instar larva, side view showing internal organs.
Fig. 13. Third instar larva, head, ventral view.
Fig. 14. Third instar larva, musculature of right side, three thoracic and first abdominal segments.
Fig. 15. Portion of Malpighian tube, third instar larva.

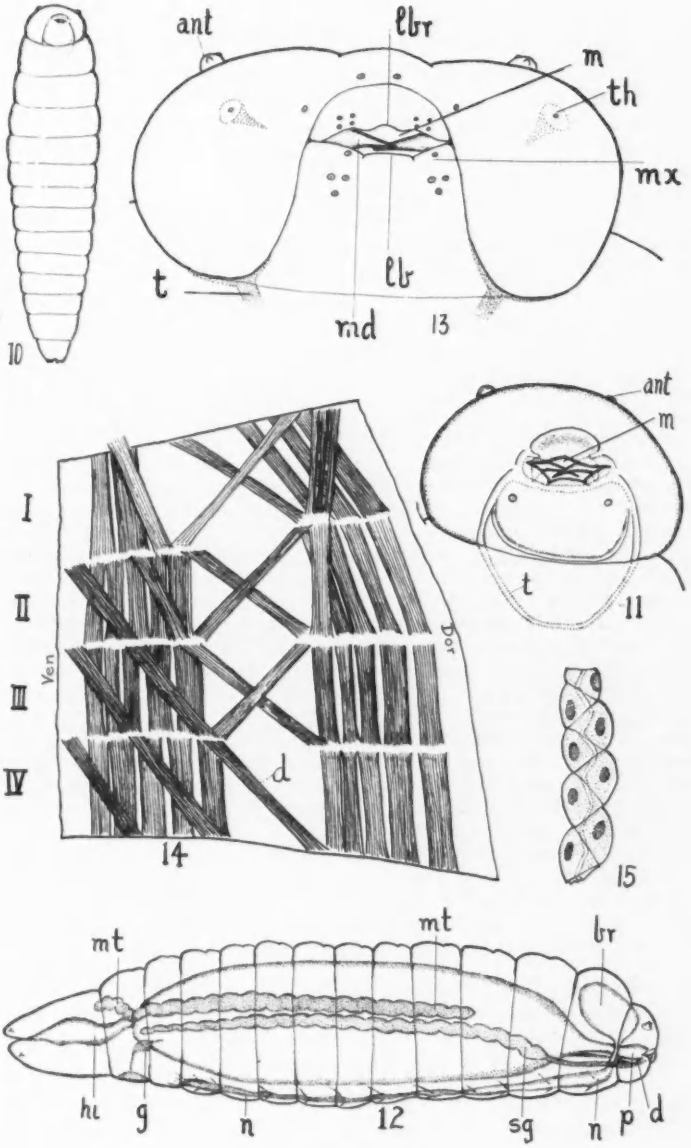
EXPLANATION OF SYMBOLS.

ant—antenna.
m—mouth.
t—tentorium.
lbr—labrum.
lb—labium.
md—mandible.
mx—maxilla.
th—thickening of chitinous head capsule.
hi—hind intestine.
g—gonad.
n—nerve chain.
sg—salivary gland.
p—pharynx.
d—duct of salivary gland.
mt—Malpighian tube.
br—brain.

Eulophus viridulus
Parker and Smith

PLATE I.

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BEES COLLECTED BY MRS. MAURICE T. JAMES IN PINGREE PARK, COLORADO.

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Pingree Park, at about 9,300 feet altitude in the Front Range of Colorado, has become classic ground on account of the annual gatherings of entomologists from all over the country. For this reason I have thought it worth while to give an account of some bees collected there in August, 1932, by Mrs. James. In future years many more species will certainly be found.

Halictus (Seladonia) ororyctes sp. n.

♀. Length about 8 mm., anterior wing about 6.3; robust, with very broad abdomen; head and thorax mainly very dark green, abdomen shining black; mandibles and antennae black, the thick flagellum faintly brownish beneath; tegulae anteriorly black, posteriorly rufous; legs black, the tarsi slightly reddish apically; perfectly white hair-bands on margins of tergites 1 to 4, but broadly interrupted in middle; wings hyaline, suffused with reddish; stigma dusky pale red, nervures pale reddish. Facial quadrangle broader than long, but face ordinary; upper part of head with pale brown erect hair; clypeus pure black, dull, with widely scattered small punctures and here and there some very minute longitudinal striae; supraclypeal area large, greenish, with sparse punctures running more or less in rows; front with extremely dense punctures; front and vertex entirely dull, the occiput a little shining and greener; mesothorax and scutellum very dark green, somewhat shining, very closely and distinctly punctured; sides of thorax and the metathorax black, the latter faintly greenish above; posterior truncation of metathorax dull, except its shining upper margin, its sides sharply defined; basal area dull except the margin, with very fine vermiform rugae all over except apically; basal nervure falling short of nervulus; hair of thorax whitish, scanty; legs with brownish hair; hind spur with five small rounded teeth, the last rudimentary; abdomen extremely minutely, not densely, punctured; venter hairy.

Colorado: Pingree Park, August 15, 1932, (Helen James). A very distinct species, remarkable for the very broad abdomen with widely interrupted white bands. It is perhaps nearest to *H. virgatellus* Ckll., but that has very dark brown nervures and smoky wings, and the tegulae very pale brown. In the European fauna it comes nearest to *H. alpinus* Alfken.

Halictus (Chloralictus) jameseae sp. n.

♂. Length about 6 mm., anterior wing about 4.6; slender, but with a broad head, the orbits strongly converging below; head, mesothorax and scutellum, dark olive green, but sides of thorax, and the postscutellum and metathorax, all black; clypeus black at apex, with no light band; flagellum very long, obscurely reddish beneath, but the sutures dark; mandibles black; tegulae almost black, not punctured; wings hyaline, iridescent, stigma dark dusky reddish, nervures brown; legs black; abdomen shining black, with a very faint greenish lustre, hardly appreciable. Clypeus and supraclypeal area completely fused, with very sparse and minute but distinct punctures; front above the antennae closely punctured; region between antennae and eyes shining; mesothorax shining, sparsely punctured, more densely punctured and minutely lineolate at sides; scutellum with very fine but distinct punctures; area of metathorax large, shining, but with no shining rim, its posterior margin not pointed (as it is in *H. pensitus* Sandh.), but obtusely subemarginate; the area has about ten strong but irregular well spaced rugae (compare *H. meritus* Sandh.); sides of metathorax beyond the area with many rugae, and the posterior truncation, which is distinctly greenish, coarsely sculptured; hair of head and thorax dull white, long and erect on scutellum; basal nervure falling far short of nervulus; outer nervures dark and hardly weakened; abdomen appearing impunctate under a lens, but there are excessively minute punctures, the smooth part of the second tergite occupies nearly half.

Colorado: Pingree Park, August 15, 1932, (Helen James). I thought this might be the male of *H. meritus* Sandh., but the sparsely punctured mesothorax and darkened stigma contradict such an assignment. Among the recorded males it comes nearest to *H. praepes* Sandh., but that is larger, with flagellum testaceous beneath, scutellum almost without punctures, the stigma and nervures dark testaceous. In *H. praepes* the third cubital cell is about twice as long as second on marginal; in our species it is much less than twice as long. There is white hair at sides of face, but no silky white covering over the whole face as in *H. viridatus* Lovell.

Colletes coloradensis sp. n.

♂. Length about 9 mm.; black, including antennae and legs; mandibles very faintly reddish apically; hair of head and thorax abundant, long and erect, dull white, faintly yellowish on face and dorsum of thorax; no dark hair on thorax; malar space (as in *C. rufocinctus* Ckll.) very short, about or nearly twice as wide as long; triangular space on metathorax shining, with a median groove; tegulae brown; wings hyaline, stigma ferruginous; costa rather dark ferruginous, subcosta black; basal nervure ending far from nervulus; second cubital

cell broad, receiving recurrent nervure about middle; second recurrent ending not very close to outer intercubitus; twelve strongly curled hooks on hind wing; abdomen with long dull white hair on first tergite; hind margins of tergites rufescent; first tergite shining, with fine but distinct punctures; tergites with only apical bands.

Very much like *C. fulgidus* Swenk and *C. nevadensis* Swenk, and of the same immediate alliance. It is certainly distinct by the genitalic characters, being closest to *C. nevadensis*, from which it differs thus: seventh ventral plate with the hairs pale and the base broader, and also with the transverse bands of small hairs as in *C. lineata* Metz, only the bands are much narrower; sagittae curved, thick, dark brown, with a very broad hyaline wing, the end of the structure (including wing) very broadly truncate (in *nevadensis* much narrower, and rounded); claspers robust, the terminal portion curved, long and narrow, with long hairs, those from the sides conspicuously plumose, but the long straight bristles so conspicuous on inner side of stipes in *C. nevadensis* wholly absent; outer side of stipes with a deep notch.

It also resembles *C. rufocinctus* Ckll, agreeing in the color of stigma and ferruginous costa, but *C. rufocinctus* is smaller, with pure white hair on thorax, and hind margin of first tergite bright red. In *C. rufocinctus* the basal nervure is closer to nervulus, and the third cubital cell is very much narrower on marginal cell than second. In the present species the third cubital cell on marginal is nearly as wide as second.

It also resembles *C. kincaidii* Ckll., but in that species the stigma is conspicuously shorter and less pointed, and the malar space is much larger.

Colorado: Pingree Park, 9,300 ft., August 15, 1932, (Helen James). The group to which this species belongs, distinguished by the abdominal characters of the male, includes *C. fulgidus* Swenk, *C. nevadensis* Swenk, *C. armatus* Patton, *C. angelicus* Ckll., and *C. lineatus* Metz. The last species occurs at Guadalajara, Mexico; the others live in the United States, from New York (*armatus*) to California (*angelicus*).

Colletes trigonatus sp. n.

♀. Length about 10 mm.; black, robust, the head and thorax with abundant long erect hair, which is very pale yellowish (without any dark hairs), white on cheeks and under side of thorax; mandibles black, flagellum very obscurely brownish beneath; face broad, orbits

strongly converging below; malar space fully twice as broad as long; disc of clypeus strongly elevated, but flattened, with an irregular median channel, the whole surface very coarsely sculptured with striae and punctures; supraclypeal area presenting an elevated triangular surface, polished but grooved, its upper end acute and narrowed to a keel; third antennal joint much longer than fourth, but not as long as next two together, suture between third and fourth joints on under side deeply incised; mesothorax strongly and closely punctured, but posterior middle with a polished impunctate space; posterior truncation of metathorax with long hair; tegulae dark reddish, wings hyaline, stigma and nervures black or nearly so, costa and subcosta both black; basal nervure not nearly reaching nervulus; second cubital cell very broad, receiving recurrent nervure slightly beyond middle; third cubital receiving second recurrent not far from end; eleven reddish hooks on hind wing; legs ordinary, anterior coxae unarmed; abdomen shining, with small but distinct punctures, hind margins of tergites very narrowly rufous; punctures of third tergite very much smaller and closer than on first; abdominal bands dense and clear white, broad and entire, on margins of tergites 2 to 4 (apparently abraded on fifth); first tergite with small white patches at sides of margin; second with a hair-band at extreme base, probably often concealed.

Colorado: Pingree Park, August 15, 1932, (Helen James). Very like *C. eulophi* Rob., the punctures of abdomen about the same, but differs by dark tegulae and stigma, and longer hair on thorax above. It resembles the Californian *C. gaudialis* Ckll. (*arenicola* Ckll.), but differs by the coarser sculpture of clypeus, and much more strongly punctured first tergite. *C. gaudialis* has the second recurrent nervure considerably more remote from end of third cubital cell.

At the same time and place, Mrs. James took a male *Colletes geranii* Ckll. and a female *C. phaceliae* Ckll., a fact which lends support to the opinion that these are sexes of one species. They both show a characteristic light reddish yellow costa, contrasting with the black subcosta. The *C. geranii* has nine large pale hooks on hind wing; the *C. phaceliae* has ten reddish hooks.

Sphecodes pulsatillae (Cockerell).

Pingree Park, August 15, (Helen James), ♀. This was described as a race of *S. hesperellus* Ckll., a species of Washington State, but I now believe it to be distinct. The mandibles are black, with a reddish subapical zone; hind wing with seven small hooks.

Melissodes fimbriata Cresson.

One male taken August 15. I do not know how to separate it definitely from this Texan species; the clypeus is lemon yellow, labrum entirely black, mandibles with a very large yellow spot. The wings are conspicuously darkened.

The other *Melissodes* taken in Pingree Park are *M. confusa* Cress., *M. hymenoxidis* Ckll., *M. mizeae* Ckll., and *M. aurigenia* Cress.

OTHER GENERA AND SPECIES.

Other genera and species from Pingree Park are the following:

Hylaeus ellipticus Kirby.

Halictus trizonatus Cress., *H. farinosus* Smith, and *H. synthyridis* Ckll.

Agapostemon texanus Cress. (abundant).

Andrena costillensis Vier. & Ckll. (both sexes).

Halictoides maurus Cress.

Clisodon terminalis Cress. (both sexes).

Anthophora montana Cress.

Bombus occidentalis Greene, *B. occidentalis nigroscutatus* Franklin, *B. bifarius* Cress. (very abundant), *B. centralis juxtus* Cress.

Osmia fulgida Cress., *O. wardiana* Ckll., *O. coloradensis* Cress., *O. armaticeps* Cress.

Titusella pronitens Ckll.

Anthidium emarginatum Say and *A. porterae* Ckll.

Coelioxys ribis Ckll., *C. cockerelli* Crawford, and *C. lucrosa* Cress.

Megachile pugnata Say, *M. relativa* Cress., *M. montivaga* Cress., *M. vidua* Smith, *M. perihirta* Ckll.

Mr. M. T. James collected *Bombus kirbyellus* Curtis and *Halictus peraltus* Ckll. (both males) on Stormy Peak, at an altitude of 11,000 feet. Franklin, in his figure of the genitalia of *B. kirbyellus*, does not show the characteristic denticulation or serration of the apical part of volsella, facing mesad. The lateral processes of the inner spathe are bidentate at end, and the broad apex of the same structure is not very well described as tridentate. The lateral corners are projecting, and from the middle there issues a narrow finger-like process.

ENZYMES IN THE DIGESTIVE TRACT OF MOSQUITO LARVAE.

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Uvarov (1928) has briefly summarized the literature dealing with the enzymes of insects and points out that the available data are somewhat more numerous than might be expected. The majority of these observations, however, were merely qualitative tests on extracts of the digestive juice or sections of the digestive tract and little information exists as to the quantitative reactions of the enzymes detected. Wigglesworth (1927–1931) has recently made extensive qualitative and quantitative studies of certain insect enzymes. Phillips (1927) and Bertholf (1927) devised an entirely different method for determining the presence of these substances in the honey-bee. The insects, adults (Phillips) and larvae (Bertholf), were fed on chemically pure carbohydrates and a comparison made as to the length of their life in contrast to that of controls fed on water alone. Phillips believes that this is a much more exact method than testing extracts of the intestinal canal since he has demonstrated that the muscles surrounding the proventriculus contained glycogen. As it is commonly held that the enzyme splitting glycogen into glucose is the same as that which splits starch into glucose, the results obtained from biochemical tests of the digestive tract (intestinal wall included) might be misleading. Neither Phillips nor Bertholf excluded micro-organisms from the intestines of the insects and it is quite possible that bacteria, etc., were responsible for the hydrolysis of the particular carbohydrates which were able to maintain the insects alive.

So far as is known to the writer there has been no study of the enzymes of mosquitoes other than that of the salivary glands of the adults, e. g., Bruck (1911) and Galli-Valerio (1916),

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etc. In connection with experiments published elsewhere the writer attempted to culture mosquito larvae in sterile solutions of chemically pure carbohydrates and amino acids. By the exclusion of microorganisms it was felt that definite information as to the presence of enzymes might be obtained provided the larvae could maintain themselves in the given solution. A preliminary abstract of this work appeared elsewhere (Hinman, 1932, b).

CULTURAL WORK.

Technique.—Chemically pure compounds were used throughout the experiments and solutions varied in strength from 1 per cent to 0.1 per cent. The chemicals were dissolved in a mixture of 50 per cent modified Ringer's Solution and 50 per cent distilled water. The formula for the Ringer's Solution being:

Sodium chloride	0.80 gms.
Calcium chloride	0.02 gms.
Potassium chloride	0.02 gms.
Sodium bicarbonate	0.02 gms.
Distilled water	100 cc.

Sterility of the solutions was obtained either by (a) autoclaving or (b) filtration through a Seitz-Werke filter. The latter method was essential in those cases where the compound was affected by heat. Two hundred and fifty cc. of the media were placed in sterile 500 cc. Erlenmeyer flasks which were previously cleansed with a fluid composed of:

Saturated potassium dichromate	2 parts
Concentrated sulphuric acid	1 part
Distilled water	1 part

The cleansing was of course followed by thorough rinsing with distilled water. After sterilization of the media, disinfected mosquito eggs were added to the cultures. The majority of tests were made with *Aëdes aegypti* Linn. since eggs of this species were available in the laboratory the year around. A few tests have been made with *Anopheles quadrimaculatus* Say and *Culex quinquefasciatus* Say, but are not reported here. Six eggs, immersed in a 1/1000 dilution of hexyl resorcinol for two minutes (see Hinman, 1932, a) were then transferred on a sterile needle to each flask and incubated at 27° C. Tests were made as to the sterility of the media at the close of each experiment and

the contaminated flasks discarded. During the past year over 200 tests have been made with the following compounds:

Soluble starch (12 samples). A one per cent solution of Litner's starch. In one experiment a single larva remained alive for a period as long as 13 days after hatching and the culture proved sterile. During this time the larva was quite active, made a slight growth, but did not moult. However, the fact that it was able to maintain itself for such a long period indicated its ability to derive nutritional elements from the starch solution. The majority of the larvae were dead by the fifth or sixth day.

Sucrose (25 samples). The maximum period of life in either 1 or 0.5 per cent cultures of this carbohydrate, under sterile conditions, was 7 days. In no case was there significant growth. Since larvae, in sterile Ringer's solution, usually died within 48 hours after hatching and invariably in 72 hours it would seem that *Aëdes aegypti* must be able to derive nutriment from sucrose.

Xylose (35 samples)—0.2 per cent solution. Of this group larvae were able to survive a week or more in two cultures, one 7 days and the other 9 days, under sterile conditions. The majority of larvae died about the fourth day. In the case of only one larva was there any apparent growth. This would seem to indicate that certain larvae may utilize this pentose to a slight extent.

Galactose (4 samples)—0.2 per cent solution. One larva lived beyond 3 days, but it would be unwise to draw any conclusions from such meager results.

Levulose (4 samples)—0.2 per cent solution. Here again a single larva lived beyond 3 days and it would be unwise to attempt to draw any inferences.

Lactose (10 samples)—0.8 and 0.4 per cent solutions. Solutions of this carbohydrate (C. P.) are apparently unable to support larval life beyond 4 days, under sterile conditions.

Maltose (10 samples)—0.8 and 0.4 per cent solutions. The maximum period of life in either of these dilutions was 5 days. Only a single larva was able to survive to this period—the majority dying about the third day.

Glycogen (30 tests)—0.5 and 1 per cent solutions. The majority of the larvae died either on the fourth or fifth day, but in three cultures at least one survived 7, 8 and 10 days, respectively, after hatching (sterile). At least two of these larvae appeared to make significant growth. Glycogen, being the reserve carbohydrate usually stored in animals, might be expected to be available for larval utilization.

Creatinine (6 samples)—0.2 per cent solution. None lived beyond the third day.

Tyrosine (6 samples)—0.2 per cent solution. A single larva lived 9 days, but one observation can not be taken as indicative of the availability of this amino acid.

Cystine (17 samples)—0.2 per cent solution. Most of the larvae died about the fourth or fifth day after hatching, but some survived

to the sixth and one to the ninth day in sterile cultures. It is interesting to note that cystine is one of the "so-called" essential amino acids (which the human body is unable to elaborate).

Mixture of tyrosine and glycogen (6 samples)—0.2 per cent solution of each. In two of these experiments larvae survived for 10 days.

A few experiments with mixtures of sucrose and tyrosine gave inconclusive results.

These cultural experiments were rather disappointing in their results and owing to certain obstacles encountered such as contamination, difficulty in determining whether the surviving larvae actually made any significant growth without moulting, whether the larvae were dead or just immobile, etc., often made a repetition with confirmation a very difficult matter. In any case from these rearing tests alone it seemed unwise to draw any definite conclusions. Therefore, an attempt was made to isolate certain enzymes from the intestinal tract of the larvae.

CHEMICAL TESTS FOR ENZYMES IN EXTRACTS OF THE DIGESTIVE TRACT OF MOSQUITO LARVAE.

The larvae of two species of mosquitoes, *Aëdes aegypti* Linn. and *Culex quinquefasciatus* Say have been tested for the presence of certain enzymes. Approximately mature larvae were washed several times in distilled water and then starved for 24 hours in several changes of distilled water, after which the intestinal tract was removed. In spite of this relatively long period of starvation the intestine usually contained considerable debris. The dissection was accomplished by placing the individual larva in a small drop of distilled water on a clean slide under a dissecting microscope and using a pair of fine needles, the entire alimentary canal was drawn out intact either from the anterior or the posterior end of the insect. The guts were stored in 50 per cent glycerin in lots of 200 each. Owing to the small size of the intestine it was thought advisable to mix together large numbers of the guts. When ready to be tested they were finely comminuted in a small agate mortar. No attempt was made to separate the intestinal tract into its component parts nor has there, as yet, been any quantitative study of the enzymes found present.

In the main the technique has been modified after Wigglesworth (1927, 1928, 1931) and Swingle (1928, 1931). In each determination of any series at least four samples were tested

and an adequate number of checks of the substrate and of the extract, separately, have been incubated to determine its reducing or hydrolysing power alone. All cultures have been incubated at 33–35° C., except in testing the liquefaction of gelatin, which was left at room temperature. Small agglutination tubes were usually used to hold samples of the mixtures.

Starch.—In the presence of amylase starch is hydrolysed to maltose, a reducing sugar. A 2 per cent starch solution was incubated overnight with samples of the glycerin extract of larval intestines and in every case positive tests for reducing sugars were given with Benedict's Reagent. A positive osazone reaction was also obtained. Incubated checks of the substrate and the extract alone were uniformly negative.

Sucrose (C. P.)—This disaccharide when acted on by invertase (sucrase) is hydrolysed to give one molecule each of glucose and levulose. A 3 per cent solution of the substrate incubated with the glycerin extract gave positive tests with Benedict's Reagent after 4 hours and also gave positive tests for osazone. The checks of the substrate and extract alone were negative in every case.

Xylose (C. P.)—A 3 per cent solution of this pentose sugar was incubated with the glycerin extract for 24 hours and its reducing power compared to that of a similar sample of the substrate (incubated under the same conditions without the extract). It was found that the mixture with the enzymatic extract had its reducing power lowered from 20–25 per cent in every case over that of the substrate alone, indicating the presence of a xylanase. It is worthy of note that Uvarov (1928) records the presence of a xylose digesting enzyme in only one case, that of Seilliere (1905) in the coleopterous larvae, *Phymatodes variabilis.*

Maltose (C. P.)—One molecule of maltose is hydrolysed by maltase to two molecules of glucose. The reducing power of the two resultant molecules of glucose is much greater than that of the single molecule of maltose. Tests of 3 per cent maltose incubated with the enzyme extract for 24 hours and longer showed no increase in reducing power (with a single exception) over that of the substrate alone, incubated for the same period. Wigglesworth (1927) has pointed out the inhibitory effect of glycerin on maltase, so a suitable dilution was made by using an excess of the maltose substrate.

Lactose (C. P.)—When this disaccharide is acted upon by lactase it is split into one molecule of glucose and one molecule of galactose. The glucose may be fermented by the use of yeast but neither the galactose nor lactose are fermented. Thus the presence of lactase may be tested for by incubating 3 per cent solution of lactose with the enzyme extract for 24 hours or longer and then determining the reducing power of one half of each sample, adding yeast to the other half and allowing this to stand at 25° C. for a few hours to give the yeast an opportunity to completely ferment any glucose that may have been liberated, then test the reducing power of the second sample. If a part of the lactose

has been hydrolysed, the glucose fraction will be fermented by yeast and that portion of the sample should show a much lower reducing power. Tests for both species of mosquitoes were negative. In these tests it was also necessary to dilute the glycerin extract to prevent its inhibitory action on the lactase.

Protease.—Tests for proteases were made with two different substrates—egg albumen and 30 per cent gelatin. The egg albumen was drawn up in fine capillary tubing, the end of the tube gently heated in a flame to prevent the material running out, and then transferred to a water bath and *slowly* heated to coagulate the albumen without bubbles. The tubing after cooling was cut in short lengths of less than 1 cm. By immersing the samples of albumen in the enzymatic extract, with the pH adjusted to various concentrations by dilute hydrochloric acid or sodium bicarbonate, the presence of a protease should be detected. Any digestion of the white albumen was readily apparent in the narrow tubes. In all cases digestion took place only in the alkaline range.

The liquefaction of gelatin was more difficult to determine, but here again definite digestion took place only in alkaline reaction. An examination of Senior-White's (1926, p. 228) observations of the hydrogen-ion concentrations of larval mosquito guts probably substantiates these results. He found that the peritrophic membrane and its contents were strongly alkaline in every case—pH 8.6–9.6 (in all but two larvae). He believes that this alkalinity must arise from the secreting cells of the midgut and not from the secretion of the caeca. The alkalinity of the midgut was found to increase toward its posterior end. This is apparently quite the opposite to the reaction of the alimentary tract of adult mosquitoes. Howard, Dyar and Knab (1912) state that Eysell fed a sweetened water solution of litmus to mosquitoes and found that in the reservoir it was blue while in the midgut and hindgut it was red. MacGregor (1931) found the diverticula to be alkaline (pH 8.5 approximately) whereas the reaction of the stomach was approximately pH 3–4. half an hour after feeding.

Lipase.—The technique outlined by Swingle (1928) was utilized in testing for the presence of a lipase. Four parts of olive oil and two parts gum arabic (acacia) were ground to a paste, three parts distilled water added and mixed to form a smooth emulsion. Brom-Thymol Blue was used as an indicator and the mixture adjusted to give a blue color by the addition of a few drops of weak NaOH solution. The enzymatic (glycerin) extract was similarly adjusted to the same pH. Fifty per cent glycerin was added to the substrate as a preservative in the checks. Thymol and Toluene have also been used as preservatives in certain series. All tubes were incubated at 35° C. for 48 hours. The presence of a lipase is indicated by the liberation of fatty acid, producing a color change from blue to greenish yellow or yellow.

Glycerin extracts of the alimentary canal of *Aëdes aegypti* and *Culex quinquefasciatus*, preserved for varying periods, gave rather indefinite reactions. In certain cases there was only a slightly greater color change in tubes containing the enzymatic extract than in the checks. However, when fresh preparations of the larval guts were

ground up and thoroughly mixed with the substrate and incubated, rather rapid reactions were obtained. Using the equivalent of 10 or more intestinal tracts in each microtube, with a small amount of substrate positive results were secured. A marked color change took place within 4 hours and at the end of 16 hours a complete change of the blue color to yellow had occurred. During this period very little change took place in the checks. From these tests it seems evident that the lipase is relatively unstable.

DISCUSSION.

The writer again wishes to point out that it would be unwise to place too much significance on the cultural experiments alone. However, in view of the chemical tests for the presence of enzymes in the larval gut these experiments (rearing) become suggestive. Starch, sucrose and xylose were found to be able to support larval life for a period of seven or more days in a limited number of cases, under sterile conditions. Enzymes for the digestion of these carbohydrates have been demonstrated to be present in the larval intestine by chemical procedure. On the other hand, maltose and lactose were not able to support larval life for a significant period nor were maltase or lactase found in the alimentary tract. No samples of pure fat or protein have been used as culture media.

SUMMARY.

1. Chemically pure carbohydrates and amino acids, dissolved in a 50 per cent Ringer's Solution have been used as media for culicid larvae, under sterile conditions. The results, in certain cases, have been rather inconclusive.

2. An amylase which readily hydrolyses starch has been found present in the intestine of both *Aëdes aegypti* and *Culex quinquefasciatus*.

3. An invertase (sucrase) which rapidly hydrolyses sucrose has been determined in the gut of both species of mosquitoes.

4. An enzyme which hydrolyses xylose is apparently present in these insects.

5. Tests for a maltase and a lactase have been negative.

6. A protease exists in the gut which digests egg albumen and gelatin in alkaline reaction. This is in agreement with the observations of Senior-White on the pH of the intestinal tract of mosquito larvae. A protease acting in acid medium was not found.

7. It is evident that a lipase is present in both of these species.

8. From purely qualitative tests there seems to be a marked correlation between the digestive enzymes present in *Aëdes aegypti* and in those of *Culex quinquefasciatus* larvae.

BIBLIOGRAPHY.

Bertholf, L. M. The utilization of carbohydrates as food by honeybee larvae. J. Agr. Res. 35: 429–452. 1927.

Bruck, C. Ueber das Gift der Stechmücke. Deutsche Med. Wochens. 37: 1787–1790. 1911.

Galli-Valerio, B. Beobachtungen über Culiciden. Centralbl. f. Bakt. Parasit. u. Infektionskr. Ite Abt. Orig. 78: 90–96. 1916.

Hinman, E. H. The role of solutes and colloids in the nutrition of anopheline larvae. Preliminary report. Amer. J. Trop. Med. 12: 263–271. 1932 a.

Hinman, E. H. Enzymes in the alimentary canal of mosquito larvae. Preliminary communication. Proc. Soc. Exp. Biol. & Med. 29: 915–916. 1932 b.

Howard, L. O., Dyar, H. G. and **Knab, F.** The mosquitoes of North and Central America and the West Indies. Carnegie Institution of Washington Publ. No. 159, Vol. 1, p. 78. 1912.

MacGregor, M. E. The nutrition of adult mosquitoes: Preliminary Communication. Trans. R. Soc. Trop. Med. and Hyg. 24: 465–472. 1931.

Phillips, E. F. The utilization of carbohydrates by honeybees. J. Agr. Res. 35: 385–428. 1927.

Seilliere, G. Sur une diastase hydrolysant la xylane dans le tube digestive de certaines larves de Coléoptères. C. R. Soc. Biol. 57: 940–941. 1905.

Senior-White, R. Physical factors in mosquito ecology. Bull. Ent. Res. 16: 187–248. 1926.

Swingle, H. S. Digestive enzymes of the oriental fruit moth. Ann. Ent. Soc. Amer. 21: 469–475. 1928.

Swingle, H. S. Notes on digestion in seven species of insects. Ann. Ent. Soc. Amer. 24: 177–180. 1931.

Uvarov, B. P. Insect nutrition and metabolism. A summary of the literature. Trans. Ent. Soc. London, 77: 255–343. 1928.

Wigglesworth, V. B. Digestion in the cockroach. II. The digestion of carbohydrates. Biochem. J. 21: 797–811. 1927.

Wigglesworth, V. B. Digestion in the cockroach. III. The digestion of proteins and fats. Biochem. J. 22: 150–161. 1928.

Wigglesworth, V. B. Digestion in *Chyrsops silacea* Aust. (Diptera, Tabanidae.) Parasitology 23: 73–76. 1931.

THE EXTERNAL MORPHOLOGY OF LARVAL BREMIDAE AND KEY TO CERTAIN SPECIES (HYMENOPTERA).[1]

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Very little work has been done on the morphology of larval Bremidae. Except for a short discussion of the change from the larva to the pupa of the genus *Bremus*, by Packard (1895) there is practically no literature to be found on the subject. There are a number of morphological papers on larvae of related families such as those of Kellogg (1902), Kirmeyer (1909), Nelson (1924), and Snodgrass (1925).

In the fall of 1931 Dr. T. H. Frison, Chief of the Illinois State Natural History Survey, placed at the writer's disposal a large collection of bumblebee larvae and pupae which he had identified through association with the adults and by rearing. The larvae included ten species belonging to the two genera (*Bremus* and *Psithyrus*) included in the family Bremidae. These were *Bremus auricomus* (Robertson), *Bremus separatus* (Cresson), *Bremus fervidus* (Fabricius), *Bremus americanorum* (Fabricius), *Bremus terricola* (Kirby), *Bremus bimaculatus* (Cresson), *Bremus impatiens* (Cresson), *Bremus perplexus* (Cresson), *Bremus vagans* (F. Smith), and *Psithyrus variabilis* (Cresson).

I should like to express my thanks and gratitude to Dr. Frison for the use of his collection of bumblebee larvae, mentioned above, from the study of which this paper is a result. Without this material, which to our knowledge is the only collection of its kind, this morphological study of larval bumblebees would have been impossible. I should also like to express my appreciation to Dr. Wm. P. Hayes, of the Department of Entomology at the University of Illinois, under whose direction this work was done, for his advice, and helpful criticisms.

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[1]Contribution from the Entomological Laboratories of the University of Illinois, No. 155.

GENERAL APPEARANCE.

The bodies of larval Bremidae are vermiform (Figs. 1, 2, and 3) and divided into two regions, head and thorax-abdomen. The head (Fig. 1, H) is more strongly sclerotized than the rest of the body. It is yellowish brown in color, while the thorax-abdomen appears white. Distinct constrictions separate the body segments from each other. Both thoracic legs and abdominal prolegs are absent. The body is convex on all sides except the venter, which is more flattened. The bumblebee larva is typically crescent-shaped (Figs. 2 and 3) and quite similar to a scarabaeiform larva in general appearance. In old larvae, late in the last stadium, the thorax becomes bent almost at right angles to the rest of the body on the venter (Fig. 1).

THE HEAD.

The fixed parts of the heads of the ten species of bumblebees studied are very similar (Figs. 4, 5, and 6). The epicranial suture (Fig. 4, ES) extends from the occipital foramen forward and ventral to a point at or below a line drawn through the minute antennae (Fig. 4, A) which are one segmented nipple-like processes protruding from rounded, raised areas. At this point on the meson, the epicranial stem (Fig. 4, ES) divides to form two epicranial arms (Fig. 4, EA) each of which runs cephalolaterad to a conspicuous depression, the pretentorina (Fig. 4, Pta). Below the pretentorinae, each epicranial arm runs more ventrad and extends to the precoila in which the condylar preartis (Fig. 4, Pa) of the mandible (Fig. 4, Md) articulates. The vertex (Fig. 4, V) is composed of all the area laterad of the epicranial stem (Fig. 4, ES). The areas laterad of the epicranial arms (Fig. 4, EA) and below the antennae (Fig. 4, A) are the genae (Fig. 6, G). No suture separates the genae from the vertex. A short distance cephalad of the preartis (Fig. 4, Pa) is a transverse, more or less arcuate suture, the clypeolabral suture (Fig. 4, CLS). The sclerite bounded by the epicranial arms and the clypeolabral suture is the frontoclypeus (Fig. 4, FC). In all the species examined, the frontoclypeal suture is obsolete. Cephalad of the frontoclypeus and separated from it by the clypeolabral suture is the labrum (Fig. 4, L). The labrum is bilobed with a distinct notch separating the lobes.

The mandibles, heavily sclerotized, (Fig. 4, Md, and Fig. 10), articulate by means of a condylar preartis (Fig. 10, Pa) and postartis (Fig. 10, Poa) with the precoila and the postcoila located on the lower margins of the genae and postgenae. Between the preartis (Fig. 10, Pa) and the postartis (Fig. 10, Poa) of each mandible is a membranous area, the mandicoria (Fig. 10, Mdc). The mandicoria is sharply separated from the more sclerotized part of the mandible. Each mandible bears at its distal end two teeth, a small proxidentes (Fig. 10, Pd) and a larger

distadentes (Fig. 10, Dd). In the nine species of the genus *Bremus* which were considered, the distadentes of each mandible is broad at its base and roughly triangular in outline, giving the mandible a mitten-shaped appearance (Fig. 10, Fig. 7). The distadentes of the one species of the genus *Psithyrus* which was examined is falcate (Fig. 12, Dd). This difference in the shape of mandibles furnishes a constant and reliable character for distinguishing between all larval instars of the genus *Bremus* and the genus *Psithyrus* of the species studied.

The maxillae (Fig. 4, Mx, and Fig. 8, Mx) are located below the mandibles. They each consist of a finger-like lobe bearing on its distal end a remnant of galea which is not fused with the rest of the maxilla. This is the distagalea (Fig. 4, Dg). Nelson (1924), in speaking of the honeybee larva intimates that this is not the distagalea but the maxillary palpus and quotes Kellogg (1902). After an examination of prepupae of representatives of the genus *Bremus*, newly formed pupae, preimagos, and adult bumblebees, as well as prepupae and adults of the honeybee, *Apis mellifera* Linne, I am forced to the conclusion that this spine-like protuberance at the end of each maxilla is the distagalea. That this is so is shown in the sketch of the prepupal mouthparts (Fig. 11, Dg). The developing maxillary palpi were not apparent in this dissection. However, they develop far back and under the maxillae. A figure further illustrating this point is found in Snodgrass (1925, p. 300). Each maxilla bears a number of spinose projections on its inner, mesal, distal surface (Fig. 8). A number of small setae are also borne on the surface of each maxilla (Fig. 9). These vary in position and number among the species examined and do not seem to be constant in number. The maxillae of larval bumblebees are not movable. They are each joined to the submentum, on the ventral aspect, by a prominent, strongly sclerotized bar which extends cephaloventral from a point close to the occipital foramen (Fig. 9, B) and ends on the inner surface (Fig. 8, B) of the labium, just below the hypopharynx (Fig. 8, Hx). All of the maxillary characters mentioned above apply equally well to all the species of the genus *Bremus* and of the genus *Psithyrus* which were examined.

The labium (Fig. 8, Li) is an area located between and below the maxillae (Fig. 8, Mx). It bears two more or less spinose areas on its inner surface, just mesad of the point of juncture with the maxillae, which comprise the hypopharynx (Fig. 8, Hx). At the distal end of the labium (Fig. 8, Li) is borne a silk duct (Fig. 8, SD) and two prominent, one segmented spine-like structures, the labial palpi (Fig. 8 and Fig. 9, LP). That these are labial palpi is shown in the formation of the prepupa (Fig. 11, LP). The ventral surface of the labium (Fig. 9) consists of a caudal area, the submentum (Fig. 9, Sm) and a distal area, the mentum (Fig. 9, M). The labium proper or mentum is separated from the submentum by a faint submento-mental suture (Fig. 9, SmMS). This suture curves caudad from one point of attachment of the mentum with one maxilla to the point of attachment with the other maxilla. The labia of the species of the genus *Bremus* and of the genus *Psithyrus* which were studied are essentially alike.

THORAX.

The thorax of larval bumblebees consists of three segments, prothorax (Fig. 1, Pt), mesothorax (Fig. 1, Mst) and metathorax, (Fig. 1, Mtt). The sutures separating the prothorax from the mesothorax and the mesothorax from the metathorax are hard to follow and are interrupted on the pleura. Each thoracic segment bears on its dorsomeson a pair of dark tubercles (Fig. 1, PtT, MstT, and MttT). The tergum of each metathoracic and mesothoracic segment is faintly divided into a cephalic and a caudal annulet. Two pairs of spiracles are borne on the thorax. These are the mesothoracic and metathoracic spiracles, but appear to be borne caudolaterally on the prothorax and mesothorax (Fig. 1, 2, and 3, Sp). On older larvae, about to moult, the developing meso- and metathoracic wings are visible through the chitin ventrad of the meso- and metathoracic spiracles (Fig. 3, WB).

ABDOMEN.

There are ten abdominal segments in all larval bumblebees (Figs. 1, 2, and 3). The first eight of these each bear a pair of spiracles on their lateral aspects. The intersegmental sutures of both the genus *Bremus* and the genus *Psithyrus*, with the exception of *Bremus auricomus*, are interrupted on the lateral aspects of abdominal segments one to nine (Figs. 2 and 3). On *Bremus auricomus* the intersegmental sutures are distinct (Fig. 1). The lateral aspects of abdominal segments one to nine are raised as prominent and characteristic pleural lobes (Fig. 1, PL). The abdominal segments of all the larvae examined are divided into two annulets on the dorsum, a cephalic annulet and a slightly raised caudal annulet (Figs. 1, 2, and 3). The venters of the abdomens of the larvae studied are simply (Figs. 2 and 3) or more complexly (Fig. 1) lobed. The tenth abdominal segment bears on its distal end an arcuate slit, the anal opening (Figs. 1, 2, and 3, AO).

SPECIFIC DETERMINATION.

A study was made of nine species of the genus *Bremus* and of one species of the genus *Psithyrus* with the aim of discovering characters by which the different larvae might be keyed to species. All the larvae were found to be very similar in structure and difficult to separate on any basis such as the arrangement of setae or differences in arrangement of the sutures. Of all the larvae examined, *Bremus auricomus* was found to be by far the most primitive. It was the only species of which the intersegmental sutures were uninterrupted on the abdominal pleura. The genus *Psithyrus*, although similar in body configuration to all the species examined, with the exception of *Bremus auricomus*, is readily separable from the genus *Bremus*

by the shape of the distadentes of the mandibles. On all the *Bremus* larvae the distadentes of each mandible is broad at its base and roughly triangular giving each mandible a mitten-shaped appearance as has been mentioned before. Larvae of the one species of the genus *Psithyrus* examined have the distadentes of each mandible falcate.

The species of bumblebee larvae may be separated rather readily on the basis of the shape and formations of the spiracles which vary little in various instars. Spiracles have been often used in keys to dipterous larvae (Greene, 1921, 1926) and have been suggested for use by Fracker (1915) to separate the Lepidoptera, so it is not strange to find spiracles of value in making specific determinations among the bumblebees.

For the sake of consistency, the work was based on the structure and shape of the mesothoracic spiracles. In order to make out the structures and shapes it is necessary to dissect off a spiracle and mount it on a slide. Examination must be made under the higher powers of a compound microscope. In the studies reported here, the spiracles were dissected from a larva in a pan of water, using the low power of a binocular. Next, the spiracle was mounted in glycerin and studied under the high power of a compound microscope. Checks on doubtful observations were made with a high powered research microscope.

The parts of a typical spiracle in longitudinal cross section are shown in Fig. 13. The outer part of each spiracle, or peritreme (Fig. 13, P), consists of a thin, transparent, oval or circular sclerite bearing an oval or circular opening, the spiracular opening, at its center (Fig. 13, SO). The width across the spiracular opening (Fig. 13. ab) and the shape varies with the species. The spiracular opening (Fig. 13, SO) opens into a chamber, the atrium (Fig. 13, At) which is variously ornamented with ridges or spinose projections which I have called atrial spines (Fig. 13, Spi). Entad of the atrium (Fig. 13, At) is the juncture of the spiracle with the trachea. The distance across the tracheal opening (Fig. 13, cd) from the tips of the spines on one side to the tips of the spines on the opposite side is of value in separating species of the group.

There is some variation in the width of the peritremes and the diameter of the spiracular openings between the meso-

thoracic spiracle and the abdominal spiracles of the same individual. There is also often slight variation in the length of the atrial spines of earlier instars and of the last instar of a given species. The characters of the mesothoracic spiracles used here were taken from last instar larvae.

From the study of the spiracles, if we may judge primitiveness by the standard of less specialization, *Bremus auricomus* (Robertson) (Figs. 1 and 15) is by far the most primitive species of the nine species of the genus *Bremus* examined. By the same criterion, *Bremus fervidus* (Fab.) (Figs. 28 and 29) and *Bremus americanorum* (Fab.) (Figs. 32 and 33) are the most specialized of the species of the genus *Bremus* examined. *Psithyrus variabilis* (Cresson) (Figs. 30 and 31), on the basis of the development of the atrial processes of the spiracles, seems to be closely related to *Bremus fervidus* and *Bremus americanorum*. The spiracles of *Psithyrus variabilis* (Figs. 30 and 31) are still more complex with regard to the atrial armature than either *Bremus fervidus* or *Bremus americanorum*. The spiracles of *Bremus bimaculatus* (Cresson) (Figs. 18 and 19) and of *Bremus impatiens* (Cresson) (Figs. 16 and 17) are much alike. *Bremus perplexus* (Cresson) (Fig. 21) has an atrial armature similar to that of *Bremus terricola* (Kirby) (Fig. 24). The species *Bremus separatus* (Cresson) and *Bremus vagans* (F. Smith) are also included. These relationships among larval Bremidae give further evidence that the classification of the adult Bremidae, as proposed by Frison (1927), is a natural one.

The following key is based on the characters of the mandibles, the configurations of the body, and characters furnished by the spiracles. It does not pretend to be complete but should furnish a beginning for further work on the larval forms of the group.

KEY TO THE LARVAE OF CERTAIN SPECIES OF BUMBLEBEES.

KEY TO GENERA.

1. Mandibles mitten-shaped, distidentes broad (Fig. 10).....Genus *Bremus*
   Mandibles not mitten-shaped, distidentes falcate (Fig. 12)...Genus *Psithyrus*

KEY TO SPECIES OF GENUS BREMUS.

1. Tracheal opening[1] of mesothoracic spiracle large (Figs. 15, 16, and 18)..... 2
   Tracheal opening of mesothoracic spiracles small (Figs. 21, 23, 24, etc.).... 4
2. None or but very few distinct atrial spines present in mesothoracic spiracles, (Fig. 15); pleural sutures of abdomen not interrupted (Fig. 1), pleural lobes distinct (Fig. 1).....**auricomus**
   Many well developed atrial spines present in mesothoracic spiracles (Figs. 16, 18, 21, 24, etc.); pleural sutures interrupted (Figs. 2 and 3)..... 3
3. Atrial spines of mesothoracic spiracles short, fairly stout; all of approximately the same size, some branched (Fig. 16); spiracular opening large, almost round (Fig. 17).....**impatiens**
   Atrial spines of mesothoracic spiracles all of approximately the same size, but slender, pointed, unbranched (Fig. 18); spiracular opening medium sized, plainly oval (Fig. 19).....**bimaculatus**
4. None, or at most only a few, of larger atrial spines of mesothoracic spiracles branched at tips (Figs. 21, 23, 24, and 27)..... 5
   Half to most of larger atrial spines of mesothoracic spiracles branched at tips (Figs. 28 and 33)..... 8
5. Atrial spines of mesothoracic spiracles all pointed, unbranched at tips (Figs. 21 and 24)..... 6
   A few of largest atrial spines of mesothoracic spiracles branched at tips (Figs. 23 and 27)..... 7
6. Diameter of spiracular opening of mesothoracic spiracles at least twice the width of the peritreme (Fig. 25).....**terricola**
   Diameter of spiracular opening of mesothoracic spiracles less than the width of the peritreme (Fig. 20).....**perplexus**
7. But one or two irregular rows of small atrial spines in mesothoracic spiracles ectad of larger inner spines (Fig. 23).....**separatus**
   Five to six rows of small atrial spines in mesothoracic spiracles ectad of larger inner spines (Fig. 27).....**vagans**
8. Largest atrial spines of mesothoracic spiracles notched at tips, but not deeply, two to three irregular rows of small, mostly unbranched spines ectad of large inner branched spines (Fig. 28).....**fervidus**
   Largest atrial spines of mesothoracic spiracles deeply notched at tips, four to five irregular rows of small, mostly unbranched spines ectad of large inner branched spines (Fig. 33).....**americanorum**

GENUS PSITHYRUS.

1. Tracheal openings of mesothoracic spiracles small (Fig. 30), most of large atrial spines two to five branched at tips, many of large spines much branched along sides, small spines mostly unbranched (Fig. 30)..**variabilis**

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[1]The tracheal opening (Fig. 13, cd) should not be confused with the spiracular opening (Fig. 13, SO, of which the diameter is the distance, ab).

LITERATURE CITED.

Fracker, S. B. 1915. The Classification of Lepidopterous Larvae. Illinois Biolog. Monographs, II, (No. 1): 1–167.

Frison, T. H. 1927. A Contribution to our Knowledge of the Relationships of the Bremidae of America North of Mexico (Hymenoptera). Trans. Amer. Ent. Soc., 53: 51–78.

Greene, Charles T. 1921. An Illustrated Synopsis of the Puparia of 100 Muscoid Flies (Diptera). No. 2405 Proc. of the U. S. National Museum, Vol. 60, Art. 10: 1–39, Pl. 1–20.

Greene, Charles T. 1926. Descriptions of Larvae and Pupae of Two-winged Flies belonging to the Family Leptidae. No. 2651, Proc. U. S. National Museum, Vol. 70, Art. 2: 1–20, Pl. 1–5.

Kellogg, V. L. 1902. The Development and Homologies of the Mouthparts of Insects. Amer. Nat. 36: 429, 683–706, illus.

Kermeyer, R. 1909. Bau und Entwicklung der Mundteile bei Vespa vulgaris. Morph. Jahrb., 39: 1–30, illus.

Nelson, J. A. 1924. Morphology of the Honey Bee Larva. Jour. Ag. Research, 28: 1167–1213.

Packard, A. S. 1898. Textbook of Entomology. Macmillan Co., London.

Snodgrass, R. E. 1925. Anatomy and Physiology of the Honey Bee. McGraw-Hill Book Company.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Lateral aspect of last instar larva of *Bremus auricomus* (Robertson).
Fig. 2. Lateral aspect of last instar larva of *Bremus bimaculatus* (Cresson).
Fig. 3. Lateral aspect of last instar larva of *Psithyrus variabilis* (Cresson).
Fig. 4. Cephalic aspect of head of *Bremus auricomus* (Robertson).
Fig. 5. Cephalic aspect of head of *Bremus bimaculatus* (Cresson).
Fig. 6. Cephalic aspect of head of *Psithyrus variabilis* (Cresson).
Fig. 7. Cephalic aspect of right mandible of *Bremus bimaculatus* (Cresson).
Fig. 8. Ental aspect of labium and maxillae of *Bremus bimaculatus* (Cresson).
Fig. 9. Ventral ectal aspect of labium and maxillae of *Bremus bimaculatus* (Cresson).
Fig. 10. Cephalic aspect of right mandible of *Bremus auricomus* (Robertson).
Fig. 11. Ventral ectal aspect of labium and maxillae of prepupa of *Bremus bimaculatus* (Cresson), seen through larval integument.
Fig. 12. Cephalic aspect of right mandible of *Psithyrus variabilis* (Cresson).

PLATE II.

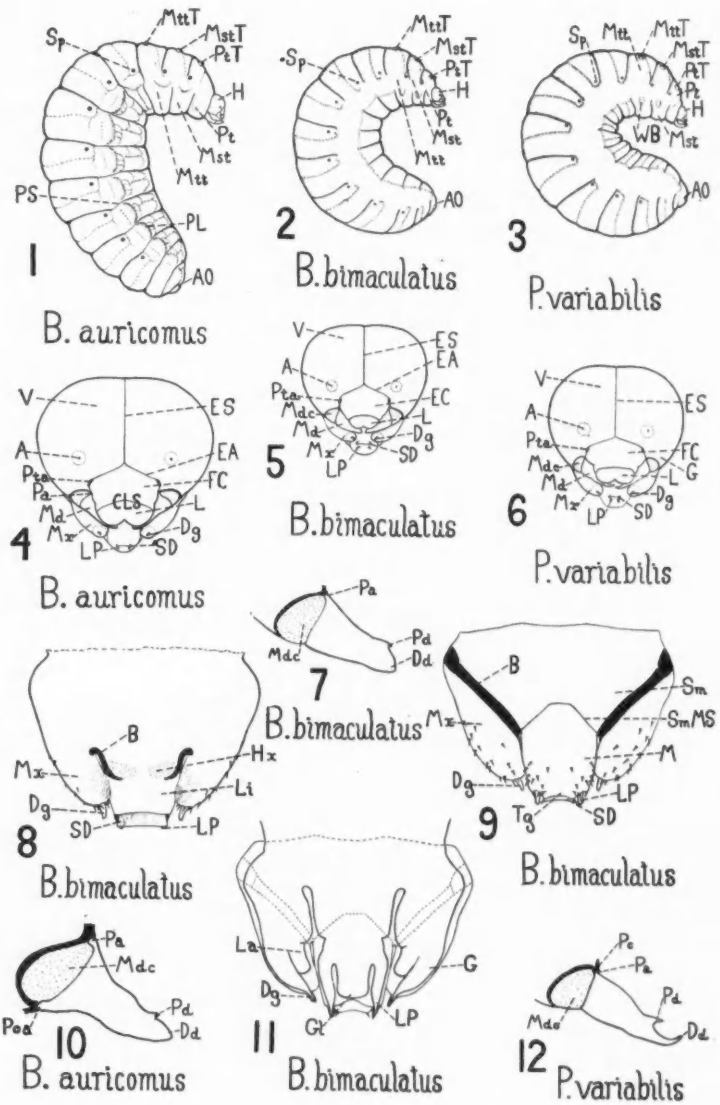
Fig. 13. Hypothetical spiracle of larval bumblebee, in longitudinal cross-section, showing relation of parts.

Figs. 14, 17, 19, 20, 22, 25, 26, 29, 31, and 32. Peritremes of mesothoracic spiracles of ten species of larval bumblebees. Fig. 14, *Bremus auricomus;* Fig. 17, *Bremus impatiens;* Fig. 19, *Bremus bimaculatus;* Fig. 20, *Bremus perplexus;* Fig. 22, *Bremus separatus;* Fig. 25, *Bremus terricola;* Fig. 26, *Bremus vagans;* Fig. 29, *Bremus fervidus;* Fig. 31, *Psithyrus variabilis;* and Fig. 32, *Bremus americanorum.*

Figs. 15, 16, 18, 21, 23, 24, 27, 28, 30, and 33. Ectal aspects of atrial chambers of mesothoracic spiracles of ten species of larval bumblebees. Fig. 15, *Bremus auricomus;* Fig. 16, *Bremus impatiens;* Fig. 18, *Bremus bimaculatus;* Fig. 21, *Bremus perplexus;* Fig. 23, *Bremus separatus;* Fig. 24, *Bremus terricola;* Fig. 27, *Bremus vagans;* Fig. 28, *Bremus fervidus;* Fig. 30, *Psithyrus variabilis;* and Fig. 33, *Bremus americanorum.*

SYMBOLS USED IN PLATES.

A—Antenna.
ab—Diameter of spiracular opening.
AO—Anal opening.
At—Atrium.
B—Bar.
cd—Diameter of tracheal opening.
CLS—Clypeolabral suture.
Dd—Distadentes.
Dg—Distagalea.
EA—Epicranial arm.
ES—Epicranial stem.
Fc—Frontoclypeus.
G—Galea.
Gl—Glossae.
H—Head.
Hx—Hypopharynx.
L—Labrum.
La—Lacinia.
Li—Labium.
LP—Labial palpus.
M—Mentum.
Md—Mandible.
Mdc—Mandicoria.
Mst—Mesothorax.
Mst T—Mesothoracic Tubercle.
Mtt—Metathorax.
Mtt T—Metathoracic Tubercle.
Mx—Maxilla.
P—Peritreme.
Pa—Preartis.
PC—Primary Cuticula.
Pc—Precoila.
Pd—Proxadentes.
PL—Pleural Lobe.
Poa—Postartis.
PS—Pleural Suture.
Pt—Prothorax.
Pta—Pretentorina.
Pt T—Prothoracic Tubercle.
SD—Silk Duct.
Sm—Submentum.
Sm MS—Submento-Mental Suture.
So—Spiracular opening.
Sp—Spiracle.
Spi—Spine.
T—Trachea.
Tg—Totoglossae.
V—Vertex.
WB—Wing Bud.


MttT
MstT
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Pt
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Mtt
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1
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2
B. bimaculatus
3
P. variabilis
WB
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L
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Md
Mx
LP
SD
Dg
4
B. auricomus
5
B. bimaculatus
6
P. variabilis
Mdc
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B. bimaculatus
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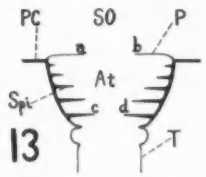
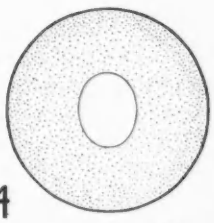
P. variabilis



13 Hypothetical Spiracle



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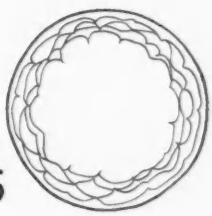

15 B. auricomus

16

17 B. impatiens

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19 B. bimaculatus

20

21 B. perplexus

22

23 B. separatus

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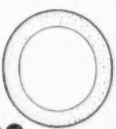
25 B. terricola

28

29 B. fervidus



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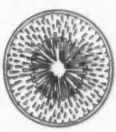

27 B. vagans

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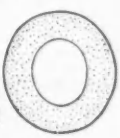
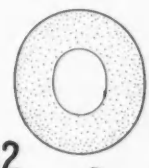


31 P. variabilis



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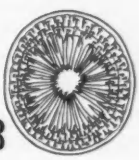

33 B. americanorum

THE MORPHOLOGY OF THE OVIPOSITOR OF DRAECULACEPHALA.

(Cicadellidae, Homoptera).

W. V. Balduf,
University of Illinois.[1]

The ovipositor of *Draeculacephala mollipes* (Say) is carried in a longitudinal receptacle (Pl. I, Fig. 8, a) in the caudoventral part of the abdomen. It consists of two pairs of chitinous valvulae (Pl. I, Figs. 1 and 2), which have come to lie mostly in the same caudocephalic plane. The anterior pair (Pl. I, Fig. 1), arising from the seventh sternite, has assumed the lateral or outer position and embraces most of the median pair (Pl. I, Fig. 2), which articulates with the eighth sternite. A third pair of valvulae (Pl. II, Figs. 1, 1) serves only as a sheath for the ovipositor proper, and arises from the eighth segment behind the posterior or median valvulae. A set of muscles (Pl. I, Fig. 8, c, c) near the apex of the abdomen probably serves to open the receptacle along its ventral edge and permits the ovipositor to assume its functioning position.

The three pairs of valvulae have the same general form, being elongate, broad, compressed appendages with pointed apices. Their outer surfaces are convex, whereas the inner faces are concave, permitting the several elements to fit compactly together.

THE SHEATHS OF THE OVIPOSITOR.

The sheaths lie mostly within the receptacle (Pl. II, 4). The upper edges of the proximal half are inseparably attached to the inside of the cavity, but the apical portions remain free and may apparently be deflexed out of the receptacle. When not in use, they are retained by an array of spurs (Pl. I, Fig. 8, b; Pl. II, 5) present on the walls of the receptacle. The individual spurs incline sharply toward the cauda of the body, and seem to be received into corresponding pits on the opposed surfaces of the sheaths. The spurs are probably forced into these pits by pressure from the abdominal muscles.

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[1]Contributions from the Entomological Laboratories of the University of Illinois, No. 159.

Cross-sections show that each sheath is composed of two united layers that differ sharply in texture, the outer of which (Pl. II, Fig. 1, a) is solidly chitinized. The inner layer is semispongy, yet strong, and obviously forms a buffer for the lateral valvula and the sheath itself. Near the upper edge (Pl. II, Fig. 1, d), the mesal layer has become modified into a row of teeth, which are so shaped and placed that they intermesh with others of similar character on the opposite sheath. Such teeth are lacking, however, in the region where the sheaths have become fixed to the receptacle walls. At the lower edge of the mesal surface, each sheath bears a prominent subangular shoulder (Pl. II, Fig. 1, e), on which rests the corresponding lateral valvula (Pl. II Fig. 2, f). The teeth on the upper edges probably interlock the two sheaths, and the shoulders apparently prevent the lateral valvulae, and thus the whole ovipositor, from slipping out of the receptacle when pressure is exerted from the sides of the abdomen.

THE LATERAL VALVULAE.

The lateral valvulae, like the other valvulae, seem originally to have been hollow appendages. Although now greatly compressed, they still retain their double-layered condition. The intravalvular space of the lateral pair has been eliminated except in the apical third (Pl. II, Figs. 2, c; 3, c). Here the layers are still widely separated, and the intervening space contains a spongy material that is easily stained with haematoxylin and is usually torn in sectioning. The outer layer is mostly solid chitin (Pl. II, Fig. 2, a), but along the basal half its ventral edge has become flexible and modified into a flap. The inner layer retains its original chitinous character at the apex of the valves, but the rest has definitely changed to a cushiony consistency (Pl. III,). The cushiony portion is corrugated and readily separates from the chitinous outer layer. Its texture suggests that it serves as a buffer against the median valvulae.

The apex and the dorsal half of the outer surface is paved with minute, mostly subrectangular, chitinous blocks that constitute a rasp (Pl. I, Figs. 1, c; Fig. 3, a, b). The blocks are separated from one another by grooves that lend the parts a varying degree of flexibility. Their form and arrangement fit them to supplement the median valvulae in preparing an

egg puncture. Penetration of the host tissue is also aided by the finely dentate apical margins of the lateral valvulae (Pl. I, Fig. 3, c).

THE INTERLOCKING MECHANISM OF THE LATERAL VALVULAE.

The ventral portion (Pl. I, Fig. 1, d; Pl. III, 1) of each valve is more flexible and expanded along the basal half than elsewhere, forming a pair of flaps, which are united along their edges by a definite interlocking mechanism (Pl. III, 4). These valvulae are consequently inseparable in life, and in dissection can be disengaged only by sliding one member lengthwise along the other. The uniting device undergoes marked structural changes in its course from the middle to the base of the valvulae. At the middle it consists of a simple ball and socket joint (Pl. III, 4). Its simple construction suggests that it resists only lateral pulls. But when seen in cross-section through the base, the interlocking device is found to have become comparatively complex (Pl. I, Fig. 5). Its terminal and lateral processes, with their complemental grooves, fit it to resist both lateral and diagonal strains. The fact that the two valvulae readily slide lengthwise upon each other indicates, however, that intergrading phases of the interlocking mechanism probably occur in the intervening positions.

Each of the lateral valvulae is also intimately combined with its corresponding median valvula. This union is performed by a simple yet efficient sliding tongue-and-groove mechanism (Pl. I, Figs. 6 and 7; Pl. III, 3). The tongue is borne on the outer face of the median valvula (Pl. II, Fig. 3, d) and the groove occurs on the mesal surface of the lateral valvula (Pl. II, Fig. 2, d). The tongue has a roughly T-like shape, (Pl. I, Fig. 6, a), and the receiving groove has a complemental form. The structure of the interlocking apparatus is uniform at all points of its course along the ovipositor. Along the basal two-thirds, it is reinforced by a thick solid substratum of chitin (Pl. III, 5, 6). Cross-sections through this thickened area reveal two longitudinal tunnels or hollows, both of which run parallel with the interlocking mechanism, one dorsad, the other ventrad. The dorsal tunnel (Pl. III, 7) is large, and elongate oval in cross-section, while the other is small, and subquadrate in form (Pl. III, 8). The hollows probably lighten as well as strengthen the valves.

In approximately the apical third, the tongue-and-groove is supported by a series of two to three teeth (Pl. I, Fig. 6, b; Pl. II, Figs. 2 and 3, e) on each of the median and lateral valvulae. They are situated just ventrad of the tongue-and-groove, and the teeth of one valvula intermesh perfectly with those of the other.

THE MEDIAN VALVULA.

The two layers of this pair of valves remain well separated in the apical third, but the interspaces have been crowded out in the proximal portions, except at the caudal or dorsal edge (Pl. III, 9). The intravalvular space contains a spongy substance like that found in the lateral pair. The outer layer (Pl. II, Fig. 3, a; Pl. III, 10, 10) is solid chitin, whereas, the inner is for most part modified into a corrugated cushiony buffer (Pl. I, Fig. 7, b; Pl. III, 11). The cushiony layer lines the structures over which the eggs presumably pass from the oviduct to the plant. The buffer is lacking, however, in about the apical third of these valves (Pl. II, Fig. 3, b), as in the lateral pair (Pl. II, Fig. 2, b). Here this layer has retained what is perhaps its original chitinous nature, it being continuous from the outer layer, and bears a series of chitinous hooks and corresponding notches (Pl. II, Fig. 3, f). The latter structures constitute an interlocking mechanism that supplements those already described.

Subapically the mesal layer remains hard only near its dorsal edge (Pl. III, 12) which is joined to the corrugated portion of the mesal surface by a strip that has a semisoft flexible composition (Pl. III, 13). The mesal wall of the ovate tunnel (Pl. III, 14) also is soft and flexible, which perhaps facilitates the safe passage of the eggs through the ovipositor.

The mesoventral edge of each median valvula is produced into a flap (Pl. I, Fig. 7, a; Pl. III, 15). The flap is present on approximately the basal two-thirds of the valve, thus being nearly coextensive with the interlocking device on the ventral edge of the lateral valvula. The flaps are chitinous, yet flexible, and lined on their mesal surface with a continuation (Pl. I, Fig. 7, b) of the corrugated layer already described. Each flap reaches more than half way across the space ordinarily existing between the two valvulae, and the pair may thus

partition the anterior part of the intervalvular cavity from that behind, as seen in cross-section.

The dorsal margin of each median valve is sharp, and bears a series of coarse teeth whose edges are finely serrate (Pl. I, Fig. 4, a). The large angular teeth (Pl. I, Fig. 2, b) occur on the apical three-fourths, while the basal fourth of the valvula is margined with smaller and rounded elevations. The apices of the valves have minute sharp teeth which obviously supplement the dentitions of the hind edge in penetrating plant tissue (Pl. I, Fig. 4, c).

The outer surface of the median valves is sculptured with crooked, subparallel transverse grooves (Pl. I, Figs. 2, d; 4, b). Each groove is rounded on the bottom and terminates in a definite pore-like opening at or near the caudal edge of the valves. Similar grooves are present on the apical fourth of the lateral valvulae (Pl. I, Fig. 3, d). The grooves of the two pairs of valvulae do not correspond in position, form, or extent. It seems plausible that they serve to conduct secretions from sexual glands to lubricate the chitinized and corrugated surfaces of the ovipositor.

HOW DOES DRAECULACEPHALA OVIPOSIT?

The efficiency of the ovipositor is due to its chitinous composition, its rasps and saws, and the several interlocking devices that unify the parts yet permit them to make both longitudinal and, to some extent, lateral movements. The puncture in which the egg is to be placed is probably effected by a series of thrusts of the ovipositor in a caudoventral direction. The form and position of the saws on the median valves shows that the ovipositor cuts backward more than ventrad in making each puncture. Due to the relative positions of the tongue and of the groove of the interlocking mechanism, the median blade is carried considerably above its companion lateral valvula. The cutting edges of the median pair are thus in position to exert their full sawing capacity on the plant.

The egg lies lengthwise in the space (Pl. III, 17) afforded by the concave mesal faces of the median valvulae. The flaps of the median valves (Pl. III, 15) probably serve to limit the space that may be occupied by the egg. The cushiony layer (Pl. III 11), the hollows (7), and the flexible area of the median valvulae

show that the path of the egg is along the intermediate portion (Pl. III, 17) of the ovipositor. The egg is presumably compressible, enabling it to pass through an opening narrower than its own normal diameter. However, the divergibility of the two valvulae composing each half of the ovipositor affords more space for the reception of the egg. The puncture made in the plant is presumably made larger than needed merely to receive the ovipositor, and therefore permits the lateral spread of its two halves. Both the egg, and the corrugated mesal lining of the median valvulae, must be lubricated to make possible the passage of the egg down into the ovipositor without rupturing its soft chorion.

It seems entirely unlikely that the egg leaves the ovipositor by way of the apex of this organ. The tapering apical third (Pl. I, Figs. 1 and 2) does not seem built to direct the egg. But this conclusion is suggested mostly by the absence of the buffer lining on the mesal surface of the apical third of the median valvulae. In its place occur sharp, bare chitinous interlocking notches and hooks (Pl. II, Fig. 3, f) which would probably tear the egg walls. The egg of *Draeculacephala* is half as long as the ovipositor itself. It therefore may enter the ovipositor without coming into contact with these bare hazardous structures. Thus it seems more likely that the egg leaves the ovipositor along the hind edge of the middle half, moving out sidewise rather than lengthwise into the puncture previously prepared. The anterior edge of the basal half of the ovipositor can not afford an exit because the flaps of the lateral valvulae are inseparably locked together (Pl. III, 1, 4). But the ovipositor is constructed to open full length along the hind edge (Pl. III, 18), and it is through this door that the egg must pass. The ovipositor is necessarily moved forward slightly during oviposition in order that the egg may be set into the puncture made for its reception.

EXPLANATION OF PLATE I.

Fig. 1. *Lateral valvula.* Side view, from without. a. Membrane connecting valvula and oviduct; b. Caudal edge of valvula; c. Rasping area; d. Anterior or ventral edge, line showing location of mechanism that unites the lateral valvulae; e. Line showing location of mechanism that unites the lateral and the median valvulae.

Fig. 2. *Median valvula.* Side view, from without. a. and b. Same as above; c. Mechanism that interlocks with e, on Figure 1; d. Grooves ending in pores near dorsal edge of valvula.

Fig. 3. *Apex of lateral valvula,* enlarged. a. and b. Detail of rasping area; c. Serrate cutting edge; d. Grooves from a longitudinal excavation, grooves ending in pores.

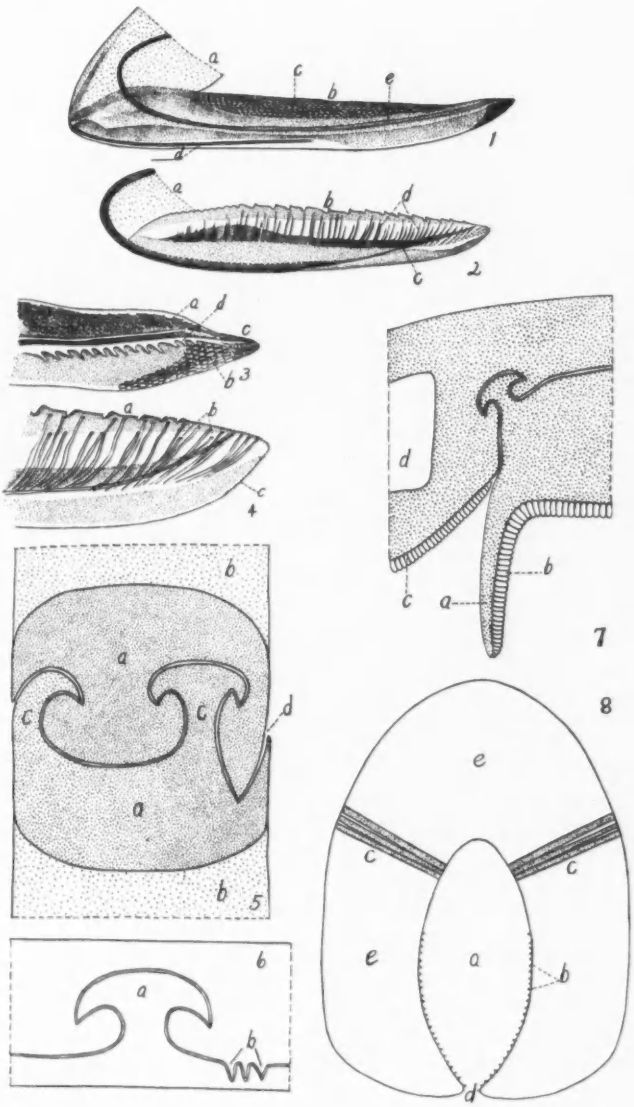
Fig. 4. *Apex of median valvula,* enlarged. a. Minute serrations of caudal cutting edge; b. Grooves and pores, shown in full in Figure 2, d; c. Finely serrated apical margin.

Fig. 5. *Device uniting lateral valvulae* near base of ovipositor, cross-section. a, a. Chitinous edges of the pair of flaps; b, b. Less chitinized submarginal areas of flaps; c, c. Hooked and T-shaped processes of uniting mechanism; d. Groove which receives complementary lateral T-shaped process from the opposite element.

Fig. 6. *Device uniting lateral and median valvulae* near apex of ovipositor, cross-section. a. T-shaped process in its complementary groove; b. Secondary interlocking teeth and notches.

Fig. 7. *Mechanism uniting lateral and median valvulae* in basal half of ovipositor, cross-section. a. Chitinous flap on ventral or anterior edge of median valvula; b. Corrugated, cushiony layer of flap; c. Same, on mesal face of lateral valvula; d. Hollow in outer layer of lateral valvula.

Fig. 8. *Apical third of ovipositor region of abdomen,* cross-section. a. Receptacle of ovipositor; b. Chitinous spurs on wall of receptacle; c. Obliquely transverse muscles joining outer body wall and wall of receptacle; d. Ventral opening of receptacle; e, e. Body cavity here occupied by alimentary canal, muscles, and adipose tissue.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EXLANATION OF PLATE II.

Cross-section through apical third of receptacle, sheath, and ovipositor. Right half shows valvulae, sheaths, and receptacle wall in their natural relative positions. On the left, the sheath and the two valvulae of the ovipositor are separated to clarify their structure.

Fig. 1. *The Sheaths of the ovipositor.* a. Chitinous outer layer; b. Spongy inner layer; c. Line of union of the two layers; d. Chitinous interlocking teeth near caudal or dorsal edge; e. Shoulder on ventral edge.

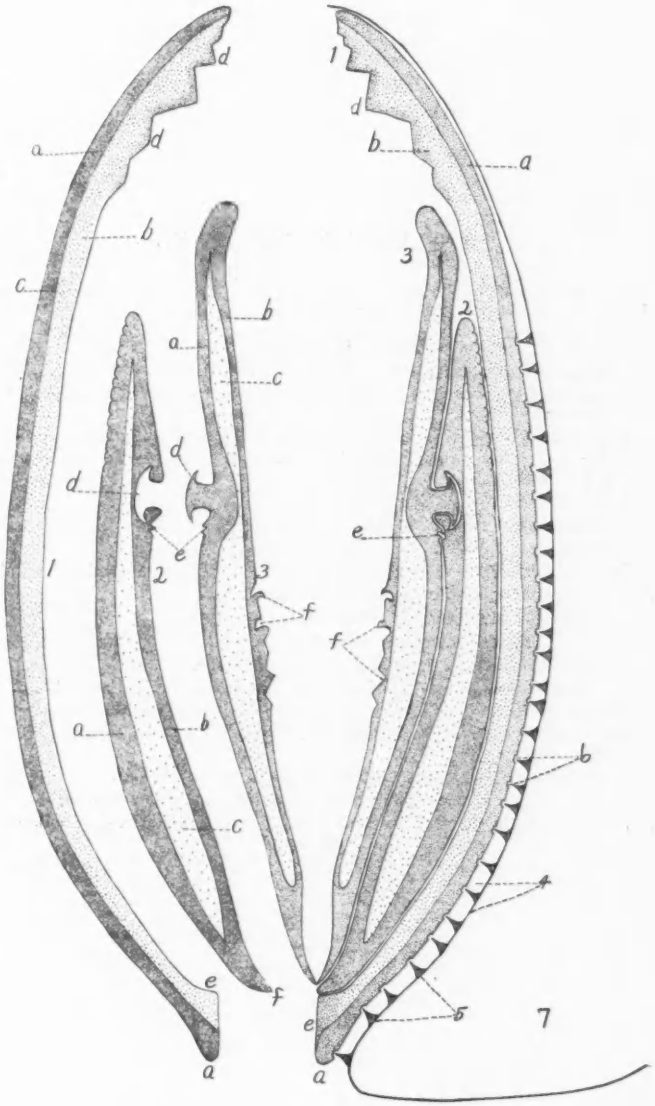
Fig. 2. *The lateral valvulae.* a. Chitinous outer layer; b. Chitinous inner layer; c. Spongy stainable matter in cavity of valvula; d. Groove of mechanism that unites lateral and median valvulae; e. Secondary teeth and notches that interlock with complementary structures on the median valvula. f. Ventral edge of lateral valvula that rests on shoulder of sheath.

Fig. 3. *The median valvulae.* a. Chitinous outer layer; b. Chitinous inner layer; c. Spongy stainable matter in cavity of valvula; d. Tongue, or T-shaped process of mechanism uniting median and lateral valvulae; e. Same as in Figure 2, above; f. Notches and hooks that interlock with complementary structures on the other median valvula.

Additional explanations. 4. Wall and cavity of receptacle of ovipositor; 5. Chitinous spurs on wall of receptacle; 6. Pits in outer layer of ovipositor sheaths; 7. Body cavity.

Ovipositor of Draeculacephala
W. V. Balduf

PLATE II.



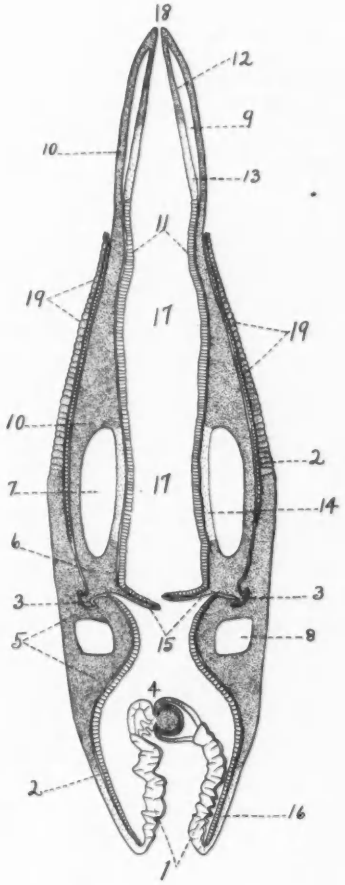
EXPLANATION OF PLATE III.

Cross-section through basal half of ovipositor, showing the pairs of lateral and median valvulae in their natural relative positions.

1. Flexible ventral flaps of lateral valvulae.
2. Inner layer of lateral valvulae modified into a corrugated cushiony buffer.
3. Tongue-and-groove devices that interlock the two valvulae of each half of the ovipositor.
4. Ball and socket joint uniting ventral flaps of lateral valvulae.
5. Thickened chitinous region of lateral valvulae, reinforcing the tongue-and-groove mechanism.
6. Same, on median valvula.
7. Hollow in outer layer of median valvula.
8. Same, lateral valvula.
9. Intravalvular space in caudal or tooth-bearing portion of median valvulae.
10. Chitinous outer layer of median valvula.
11. Corrugated spongy inner layer of same.
12. Chitinous area of inner layer of median valvula.
13. Semi-soft transitional area of inner layer of same.
14. Semi-soft inner wall of tunnel through outer layer of median valvula.
15. Pair of chitinous flaps arising from ventral edges of median valvulae.
16. Semi-flexible area of outer wall of lateral valvulae forming base of flexible flaps of these valvulae.
17. Intervalvular space that receives the egg from the oviduct.
18. Point at which eggs probably pass laterally from the ovipositor.
19. Blocks of chitin that compose the rasping area of the lateral valvulae.

Ovipositor of Draeculacephala
W. V. Balduf

PLATE III.



HYMENOPTEROUS PARASITES OF GYRINIDAE WITH DESCRIPTIONS OF NEW SPECIES OF HEMITELES.

F. GRAY BUTCHER,
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In a study on the biology of various Gyrinidae[2] at the Douglas Lake Biological Station during the summer of 1929, a fairly large series of hymenopterous parasites were reared from the pupae of species of *Gyrinus*. Most of these parasites proved to be *Hemiteles hungerfordi* Cushman, which was first reared by Hungerford from these hosts in 1927. However, several individuals were quite distinct from this or any other species described as parasitic on these beetles, and upon careful examination three other species were recognized, one of which has been determined by Dr. R. A. Cushman as *Bathythrix pimplae* Howard, and the other two as undescribed species of *Hemiteles*. Inasmuch as *Bathythrix* is considered by some authors as a subgenus of *Hemiteles* (see Vireck, Conn. Nat. Hist. Surv. Bul. 22), it will be so considered here for the sake of simplicity. Descriptions of these two species follow:

Hemiteles cushmani, species new.

Female.—Length, 4.5 mm. Antennae length, 3.5 mm.

Head twice as broad as thick; temples convexly sloping, convexity continuous with that of the eyes; temples, cheeks, and vertex subopaque, faintly alutaceous; frons subopaque, shagreened, with a median groove; ocelli in diameter one-half length of ocellocular line, which is as long as length of postocellular line; eyes nearly parallel, very slightly divergent below; face slightly broader than long, opaque; clypeus deeply separated from face, more shining, twice as broad as long, bidenticulate apically; malar space as long as basal width of mandible; antennae slightly thickened beyond middle, flagellum 17-jointed, basal joints slender, twice as long as the gradually shortened apical joints. Thorax stout, shagreened; pronotum opaque, indistinct groove across collar; mesoscutum opaque, notauli deep, short, convergent posteriorly; scutellum

[1]Contribution from the Biological Station, University of Michigan and the Department of Entomology, University of Kansas. The author wishes to express his appreciation for the assistance rendered by Dr. R. A. Cushman, of the U. S. National Museum, in the identification of specimens and in the preparation of the new descriptions. This paper could hardly have been completed had it not been for his kind criticisms and many helpful suggestions.

[2]*See* F. Gray Butcher, Journal Kansas Entomological Society, Vol. III. pp. 64-66.

subopaque, convex, scutellar fovea deep and broad; mesopleurum and sternum subopaque; metapleurum and propodeum opaque, propodeum broad; areolation complete, definite, propodial carinae strong; areola hexagonal, slightly longer than broad, anterior margin one-half as wide as posterior margin; spiracle very small, inconspicuous, midway between lateral and pleural carinae; legs slender, hind basitarsus twice as long as second joint, third and fifth joints subequal, fourth joint one-half as long as third joint; stigma large, covering slightly less than one half as much area as does the radial cell; areolet pentangular, large, entirely open at apex; discocubitus broken, ramellus lacking; subdiscoideus far below middle of postnervulus; intercubitus more than half as long as first abscissa of radius. Abdomen, except first segment, polished; first segment subopaque, in profile strongly curved, twice as broad at apex as at base, dorsal carinae strong, divergent and weakening at apex, lateral carinae strong to apex, spiracles in center just below them; abdomen beyond first segment broadly oval, epipleura of tergites two and three moderately broad, separated from rest of tergites by carinae; ovipositor sheath slender, slightly longer than first segment.

Color black except second and third abdominal segments which are ferruginous; antennae dark; legs rufotestaceous, hind coxae darker, apex of hind femora, tips of hind tibia, and apical tips of middle tibia blackish; all tarsi apically darker; wings hyaline, venation and stigma dark except angles of stigma on the costal margin which are light; mandibles reddish, darker at apices.

Male.—Much like female, flagellum stouter, 18-jointed; abdomen more slender, basal margin of fourth segment ferruginous in color.

Type locality.—Burt Lake, mouth of Maple River, Michigan.

Described from a series of six females and five males reared from *Gyrinus* cocoons by the author during the summer of 1929, and one male reared from same host by Dr. H. B. Hungerford during the summer of 1927. Holotype, allotype, and paratypes in the Entomological Museum, University of Kansas, Lawrence, Kansas, and female and male paratypes (U. S. N. M. No. 43549) in the U. S. National Museum, Washington, D. C.

Hemiteles cheboyganensis, species new.

Female.—Length, 3.5 mm. Antennae length, 3.5 mm.

Head a little more than twice as broad as thick; temples convexly sloping, convexity continuous with that of the eyes; temples, cheeks, frons, and vertex behind ocelli shining and very faintly alutaceous; frons with a distinct median groove; ocelli in diameter nearly equal to length of lateral ocellar line, which is about half as long as postocellular line; ocellocular and postocellar line subequal; eyes slightly divergent below; face fully twice as broad as long, opaque punctate; clypeus separated from face, more shining, less distinctly punctate, nondenticulate apically; malar space fully as long as basal width of mandible; antennae considerably thickened beyond middle, flagellum 19-jointed,

basal joints slender, twice as long as apical segment, subapical segment twice as long as thick. Thorax somewhat compressed, nearly as high as long; pronotum opaque, finely punctate, distinct transverse groove across collar; mesoscutum impunctate, subopaque, notauli present, not deeply impressed, confluent posteriorly; scutellum subopaque, convex, scutellar fovea deep and fairly broad; metapleurum and propodeum opaque, roughly punctate; areolation complete, carinae distinct, apical transverse carina especially strong; areola hexagonal, slightly broader than long; spiracle small, midway between lateral and pleural carinae; legs slender, hind basitarsus slightly more than twice as long as second joint, third and fifth joints subequal; hind coxae opaque; stigma broad, about one-third as large as radial cell; radial cell short, not longer on metacarpus than stigma; areolet medium size, pentangular, entirely open at apex; discocubitus broken; ramellus lacking; postnervulus nearly straight with subdiscoideus considerably below middle; intercubitus more than half as long as basal abscissa of radius. Abdomen shining, first tergite rather weakly shagreened, in profile fairly strongly curved, thicker in middle than at base, twice as broad at apex as at base, dorsal carinae parallel to beyond middle then divergent and becoming weaker apically, lateral carinae strong to apex, spiracles in middle located on rather prominent tubercles; abdomen beyond first segment broadly oval, epipleura broad, inflexed; ovipositor sheath not longer than first segment.

Head, thorax, and first segment of abdomen black, remainder of abdomen rufotestaceous, second and third tergites darker apically; legs testaceous, hind coxae black at base, tarsi darker apically; wings hyaline, venation dark, stigma lighter at base; mandibles reddish, apically dark.

Type locality.—Burt Lake, mouth of Maple River, Michigan.

Described from two females reared by the author from cocoons of *Gyrinus* species during the summer of 1929. Holotype in the Entomological Museum, University of Kansas, Lawrence; female paratype (U. S. N. M. No. 43548) in the U. S. National Museum, Washington, D. C.

This makes five species of these ichneumonid wasps reared from this host in America, to which may be added the European species, *Hemiteles argentatus* Grav., which was reared from pupae of *Gyrinus* by Parfait in 1881. *Hemiteles gyrinophagus* Cushman was reared from a pupa of *Gyrinus* by Wickham in 1894. The five North American species now known are *Hemiteles cushmani* n. sp., *H. pimplae* Howard, *H. gyrinophagus* Cushman, *H. hungerfordi* Cushman, and *H. cheboyganensis* n. sp. The American species may be separated by the following key, which is largely adopted from a similar key proposed by Dr. Cushman in private correspondence.

KEY TO NORTH AMERICAN SPECIES OF HEMITELES PARASITIC IN COCOONS OF GYRINUS.

1. Body generally (notably head, mesoscutum, and abdomen) smooth and polished, more or less distinctly punctate in part; notauli distinct and deep throughout; epipleura of tergites 2 and 3 membranous, or if distinct not separated by carinae 2

   Body generally opaque shagreened, abdomen less distinctly so; notauli impressed only anteriorly; eyes divergent below; malar space equal in length to basal width of mandibles; clypeus bidenticulate apically; postocellar and ocellocular lines subequal, diameter of an ocellus much less than either; areolet large, intercubitus much more than half as long as first abscissa of radius; tergites 2 and 3 with distinct broad epipleura, separated from rest of tergites by carinae; abdomen black at base and apex, reddish in middle. (Page 76) ..... **cushmani**

2. Eyes convergent below; malar space much shorter than basal width of mandible; clypeus bidenticulate at apex; diameter of an ocellus nearly or quite as long as postocellar line, which is much shorter than ocellocular line; areolet small, intercubitus much less than half as long as basal abscissa of radius; hind coxae smooth, shining; epipleura of tergites 2 and 3 membranous 3

   Eyes divergent below; malar space nearly or quite as long as basal width of mandible; clypeus not bidenticulate at apex; diameter of an ocellus much shorter than length of postocellar line, which is fully as long as ocellocular line; areolet large; intercubitus more than half as long as basal abscissa of radius; hind coxae opaque; epipleura of tergites 2 and 3 distinct and broad, not separated off by carinae 4

3. Hind femur and tibia black apically; tarsus more or less reddish, at least at base of joints; clypeal denticles distinct; sternal plates of sixth abdominal segment of male widely separated ..... **pimplae**

   Hind femur entirely reddish; tibia fuscous, paler below; tarsus entirely fuscous; clypeal denticles very minute; sternal plates of sixth abdominal segment in male contiguous medially ..... **gyrinophagus**

4. Abdomen piceous black; postocellar line much longer than ocellocular line; diameter of an ocellus not nearly half as long as postocellar line, **hungerfordi**

   Abdomen, except first segment, pale reddish, with tergites 2 and 3 darker apically; postocellar and ocellocular line nearly equal; diameter of an ocellus about half as long as either. (Page 77) ..... **cheboyganensis**

NOTES ON THE PARASITES.

Adults of these parasites were obtained by rearing them from cocoons of *Gyrinus* which were placed in small vials with cellucotton stoppers. Later in the season, the parasites were reared quite successfully in small paraffin cells made by sinking a heated nail-head into a paraffin block. The parasitized host larva was removed from its pupal case and placed in the paraffin cell, and then a small cover glass was heated and placed on the cell, a small air-hole being made by means of a "minuten nadeln." By this method, the development of the insects, which feed externally upon the host larvae, could be carefully observed under the binocular.

Oviposition was first observed in the laboratory from females which had been reared from host cocoons and kept

isolated. Eggs deposited by these females developed into adults, demonstrating that these insects can reproduce parthenogenetically. Later in the season the two sexes were mated, and although there was not sufficient time to get enough offspring from these fertilized females to draw any definite conclusions it is worthy of notation that only males were reared from unfertilized eggs, and that the two adults reared from fertile eggs were females.

When a newly constructed host cocoon was placed in an isolation vial, the wasp would crawl over it, constantly feeling with her antennae for any break, or pit, in the surface. When a suitable place was located, the wasp moved forward slightly until the hind legs were in line with the abrasion located on the cocoon. Then the abdomen was lifted, and the ovipositor placed between the hind legs, from which position it was inserted into the cocoon. During this operation, there was a slight movement back and forth as the ovipositor sawed through the case. After it was forced into the cocoon the host larva was apparently stung by three or four thrusts of the ovipositor, each time the ovipositor being extended its full length. That the host larva was injured during egg deposition is demonstrated by the fact that it failed to develop even if the parasitic egg was removed, while unparasitized host larvae would develop normally if removed from their pupal case and placed in the paraffin rearing cells. The host was greatly disturbed by egg deposition, and if the cocoon was opened immediately thereafter, the larva was nearly always twisting and turning within its case, trying to dislodge the egg, and in some instances the larvae were observed crushing the eggs with their mandibles. The eggs were attached rather insecurely to any portion of the host, and occasionally were found loose within the cocoons.

In the laboratory the females oviposited any time during the day, but were never taken in the field except early in the morning. The only additional information field studies gave on oviposition habits was the method the wasps used in finding the host cocoons. All that were observed searched for the cocoons in the same manner, namely, by crawling up a stem in a wide spiral from near the water line to the top of the reed upon which the cocoons are normally constructed. If no cocoons were present on this reed the wasp would fly to the lower portion of another nearby reed and crawl up in the same

manner. This was continued until a host cocoon was found, then oviposition took place as described above.

LIFE HISTORY OF HEMITELES HUNGERFORDI CUSHMAN.

The eggs of this species are of a deep cream color. The general shape is elongate-oval, with a slight tapering at each end. They average about 0.56 mm. long and 0.15 mm. wide. The eggs hatch after about two days incubation, the young larvae being about 0.7 mm. long, twelve-segmented, and with a distinct head capsule. The larva is very light in color, but as it continues growing, the color darkens to a testaceous hue. It travels about over the host larva in a geometrid fashion, apparently using the tip of the abdomen and the mouth parts as organs of locomotion.

The larvae feed externally upon the body of the hosts, apparently sucking out the body fluids. During the period that the larvae are feeding, their size increases rapidly, but no definite molts were observed. The full grown larva is 4 to 6 mm. long. In from five to seven days, the larva begins spinning its pupal cocoon. This is usually entirely black, and is generally uniform elongate-oval in outline, but sometimes there is a constriction in the center which is lighter in color and which gives to the cocoon a lobed appearance. It is attached to the inside of the host cocoon, and normally a complete silken case is formed. However, in the paraffin rearing cells a definite cocoon frequently was not constructed and the cell was but sparsely lined with silk. The spinning of the silken cocoon required from two to three days, after which pupation occurred.

In no case was more than one larva found upon a single host. In the laboratory, two or three eggs were placed upon a single host larva, but only the strongest individual developed and at the expense of his brothers. It is true that one host larva would not provide sufficient food for more than one of these parasites, so it is quite necessary that they should be cannibalistic.

The pupa is typically hymenopterous, dark in color, and slightly smaller than the adult. The length of the pupal period varies between five and seventeen days. In only one instance was this stage observed to require more than ten days, and omitting this one instance, the average time for this

period was seven days. No explanation can be given for the one instance where this stage was of unusual length.

Emergence of the adult is accomplished by the wasp cutting its way through the top of the cocoon. The top of its own cocoon is first cut away, and then a small circular hole, about one milimeter in diameter, is cut in the host cocoon.

In isolation vials, the adults lived about 36 hours without food. During this period they were quite active within the vials. By feeding the wasps a mixture of 40 per cent honey and 60 per cent water, they were kept alive for about three weeks, and they died then only because the work was discontinued to allow time for other activities. The fact that the wasps were slightly positively phototropic simplified somewhat the feeding operations.

The life histories of *H. cushmani*, *H. cheboyganensis*, and *H. pimplae* Howard differ but little from the life history of *H. hungerfordi* Cushman. The descriptions of the immature stages of *H. hungerfordi* Cushman serve equally well for the respective stages of all of these species.

It is interesting to note that the insects of this group are generally reported to be hyperparasites, and that *H. pimplae* Howard was first purported to have been reared as a secondary parasite of the white-marked tussock moth, *Hemerocampa leucostigma* A. and S. However, these studies indicate clearly that these species are definitely primary parasites of *Gyrinus* larvae within their pupal cases.

NOTES ON CYRTOGASTER DINEUTES ASHMEAD.

While carrying on the studies of the *Hemiteles* species, specimens of the chalcid *C. dineutes* Ashmead were discovered emerging from *Gyrinus* cocoons. This species was first recorded as parasitic on gyrinids by Wickham in his study of *Dineutes assimilis* Aube, and it has often been considered a secondary parasite of this insect, but no records of its occurrence as a parasite of *Gyrinus* have been found.

By the same technique as that used in the study of the ichneumonids, namely, the isolation vials and the paraffin cell rearing cages, *C. dineutes* Ashmead was successfully reared through two, and a partial third, generations. These studies clearly demonstrated that this species is also a primary parasite of *Gyrinus* larvae within their pupal cases, the young parasitic

larvae feeding externally upon the host larvae in much the same manner as do the larvae of *Hemiteles*.

The method of oviposition is similar to that described for the *Hemiteles* species. A pit on the surface of the host cocoon is located with the antennae and the ovipositor inserted at that location. This species seemed to paralyze the host more completely than did the ichneumonids, and the host larva was usually quiet after the egg had been deposited.

The egg is similar in appearance to that of the ichneumonids. It is of the same creamy color, and of the same general shape, but is slightly shorter, the average measurements being about 0.4 mm. long and 0.13 mm. wide. It is insecurely attached to any portion of the host larva. The incubation period occupies about two days. The newly hatched larva is about 0.52 mm. long; no definite metameric segmentation can be distinguished. This larva is slightly darker in color than the *Hemiteles* larva, and is not so active. It feeds externally upon the body of the host from four to six days, and then transforms into a naked pupa. The full grown larva measures approximately 1.9 mm. long and 1.0 mm. wide.

The pupae average about 2.2 mm. long. They are very light in color for three or four days, and then become dark. The entire pupal stage averages a little over six days.

Usually from four to six individuals of this species emerge from a single host cocoon. The greatest number reared from one host larva was nine individuals, and these were all considerably smaller than the average.

From the fact that more than one individual is reared from a single host, and also that the life cycle is completed in approximately the same length of time as that of the *Hemiteles* species, it is not surprising that the chalcid parasites were more abundant at the close of the season than were the ichneumonids.

REFERENCES CITED.

Ashmead, W. H. Descriptions of two new hymenopterous parasites from water beetles. Can. Ent. 26: 24–26. 1894.

Cushman, R. A. New parasitic hymenoptera. Proc. U. S. Nat. Mus. 76, Art. 25. 1930.

Howard, L. O. A study in insect parasitism. U. S. D. A. Bur. Ent. Tech. Bul. 5: 31, 54. 1897.

Parfait, E. Two new species of Ichneumonidae. Ent. Monthly Mag. 18: 78–79. 1881.

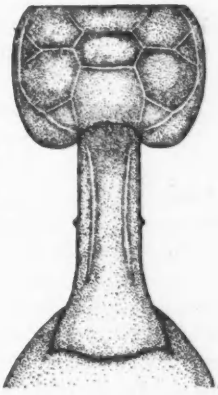
Wickham, H. F. On some aquatic larvae, with notice of their parasites. Can. Ent. 26: 39–41. 1894.

EXPLANATION OF PLATE.

Fig. 1. *Hemiteles* (*Bathythrix* sub. g.) *pimplae* Howard.
Fig. 2. *Hemiteles hungerfordi* Cushman (pupa).
Fig. 3. *Hemiteles cheboyganensis* Butcher. Propodeum of adult.
Fig. 4. *Hemiteles hungerfordi* Cushman (egg).
Fig. 5. *Hemiteles hungerfordi* Cushman (larva).
Fig. 6. *Hemiteles cushmani* Butcher. Propodeum of adult.
Fig. 7. Gyrinus cocoon.
Fig. 8. *Hemiteles hungerfordi* Cushman. Propodeum of adult.

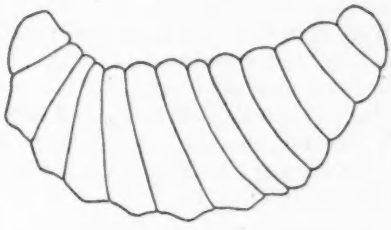
1. H. pimplae (propodeum of adult)

2. H. hungerfordi (pupa)



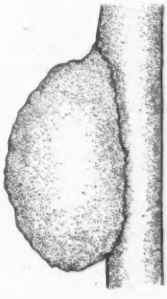
3. H. cheboyganensis (propodeum of adult)

4. H. hungerfordi (egg)

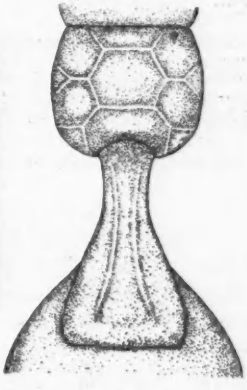


5. H. hungerfordi (larva)

6. H. cushmani (propodeum of adult)



7. Gyrinus cocoon



8. H. hungerfordi (propodeum of adult)

THE LARVAL HEAD OF PARASITIC HYMENOPTERA AND NOMENCLATURE OF ITS PARTS.

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In their studies of various hymenopterous parasites, principally among the Braconidae and Ichneumonidae, the writers have found the structures and markings of the last-stage larval head to be very useful in the determination of certain species, and it is their belief that such characters may well form the basis upon which many Hymenoptera in this stage can be separated.

The proper use of such characters has called for a rather detailed study of the heads of several species of hymenopterous parasite larvae in order that their various structures might be correlated and homologized, and this, in turn, has led to the necessity of finding suitable names by which these parts might conveniently be designated.

During the course of several years, various literature upon this subject has been consulted, and last-stage larvae of many parasitic species of the Hymenoptera have been examined. Among the larvae observed, the following have been most intensively studied:

BRACONIDAE.—*Apanteles thompsoni* Lyle, *Chelonus annulipes* Wesm., *Microgaster tibialis* Nees, *Meteorus*(*Zemiotes*) *nigricollis* Thomson, *Macrocentrus gifuensis* Ashm., *Microbracon brevicornis* Wesm., *Microplitis ceratomiae* Riley, and *Bassus simillimus* (Cress.).

ICHNEUMONIDAE.—*Phaeogenes nigridens* Wesm., *Inareolata punctoria* Roman, *Limnerium alkae* Ell. and Sacht., *Exeristes roborator* Fab., *Paniscus ocellaris* Thu., *Campoplex* (*Omorgus*) *multicinctus* Grav., *Campoplex pyraustae* Smith, *Phygadeuon vexator* Thu., *Ephialtes geniculatus* Krb., *Exetastes illusor* Gr., *Cryptus spinosus* Gr., and *Itoplectis ephippium* Br.

CHALCIDIDAE.—*Pteromalus puparum* L. and *Dibrachoides dynastes* Forst.

BETHYLIDAE.—*Laelius anthrenivorus* Trani.

It is realized, of course, that the list represents only a very few of the vast number of species existing in the parasitic Hymenoptera. That further studies along this line will reveal decided divergences in head structures, and probably the addition of new parts, is to be expected. The writers hope,

[1]Appreciation is expressed to H. L. Parker for his valuable aid in the preparation of this paper, and to R. E. Snodgrass, A. G. Boving, and R. A. Cushman, for their advice and many helpful suggestions in regard to nomenclature.

however, that their effort will provide an adaptable groundwork for continued research in this direction.

An attempt has been made to employ old names wherever possible and, in adding new ones, to use a simple and applicable terminology. The works of Berlese ('09) and Snodgrass ('28) have been frequently consulted.

The head structures of larvae belonging to several of the important orders of Insecta have already been adequately treated in literature. In the Hymenoptera the generalized form found in the Tenthredinoidea has been studied by Yuasa ('22). This author has, however, unfortunately employed a terminology somewhat complicated for the usage of workers with other groups of this order.

Many authors, including the writers of this paper, in their consideration of the immature stages of the parasitic Hymenoptera, have described and illustrated the head of the last-stage larva, but in most cases they have pointed out only the more prominent and generalized characters. The antennae, labrum, mandibles, maxillae, labium, mouth, opening of silk duct, maxillary and labial palpi, and sensory papillae have been considered, but little attention has been paid to various cuticular thickenings and certain other structures on the head which might further aid in the separation and determination of genera and species.

In his valuable contribution on the postembryonic forms of the Chalcididae, Parker ('24) described and illustrated a considerable number of heads of larvae belonging to that family and made use of various head characters, together with other larval features, in the separation of genera and species and in their arrangement in certain groups. This work represents the most extensive treatment published on the immature forms of any family in the parasitic Hymenoptera.

Thorpe ('30) appears to have been the first to give weight to certain morphological characters of the head of last-stage larvae as a basis for the separation of genera and species in the Ichneumonidae and Braconidae, and a study of his drawings illustrates well the worth of such a method. In his publication, which deals with the parasites of the pine shoot moth, *Rhyacionia buoliana* Schiff., he has illustrated the last-stage larval head of eight species of Ichneumonidae: *Omorgus borealis* Zett., *O. ensator* Grav., *O. mutabilis* Holmgr., *Eulimneria rufifemur* Thoms., *Cremastus interruptor* Grav., *Pimpla exami-*

nator F., *P. brevicornis* Grav., and *P. ruficollis* Grav., and of one species of Braconidae, *Orgilus obscurator* Nees.

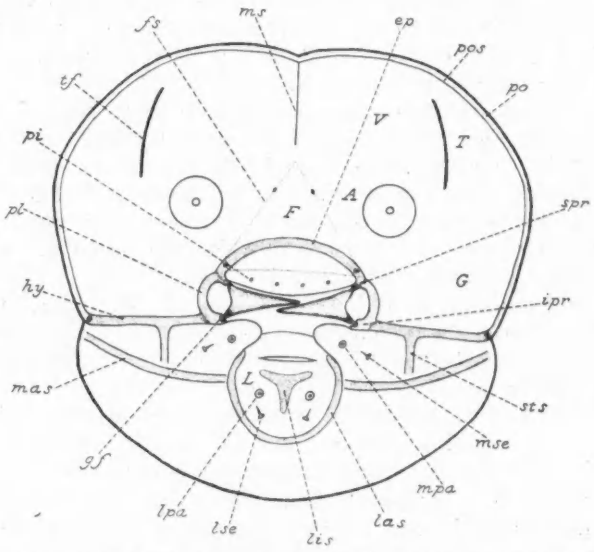

Fig. 1. Front view of typical last-stage larval head of the parasitic Hymenoptera, somewhat diagrammatical, showing external characters.

List of Abbreviations used in Figures 1–3:

a.....antenna.
A.....antennal region.
ac.....mandibular acron.
af.....antennal foramen.
atp.....anterior tentorial pit.
atr.....anterior tentorial ramus.
c.....clypeus.
ca.....maxillary cardo.
co.....mandibular condyle.
dtm.....dorsal tentorial mark.
dtr.....dorsal tentorial ramus.
ep.....epistoma.
f.....frons.
F.....frontal region.
fm.....foramen magnum.
fs.....frontal suture.
g.....glossa.
G.....genal region.
gf.....glenoid fossa.
hy.....hypostoma.
ipr.....inferior pleurostomal ramus.
L.....ligular region.
las.....labiostipital sclerome.
lb.....labiobase.
lis.....ligular sclerome.
lm.....labrum.
lpa.....labial palpus.
ls.....labiostipites.
lse.....labial seta.
mas.....maxillary sclerome.
md.....mandible.
mlo.....maxillary lobe.
mpa.....maxillary palpus.
ms.....metopic suture.
mse.....maxillary seta.
mx.....maxilla.
pc.....preoral cavity.
pi.....papillus.
pl.....pleurostoma.
po.....postocciput.
pos.....postoccipital suture.
ptp.....posterior tentorial pit.
sdo.....orifice of silk duct.
spr.....superior pleurostomal ramus.
st.....maxillary stipes.
sts.....stipital sclerome.
T.....temporal region.
tf.....temporal fossa.
ttb.....transverse tentorial bar.
V.....vertex.

This author laid most of his emphasis on the more prominent thickenings on the front of the head, and these characters are certainly of great value. He did not, however, make use of certain other head characters which are often of some specific importance. The writers take exception to Thorpe's use of "tentorium" to include the various thickenings on the front of the head, i. e., his "labral strut," "mandibular strut," "maxillary strut," "labial strut," and "labial ring." The tentorium is generally understood to be only the internal

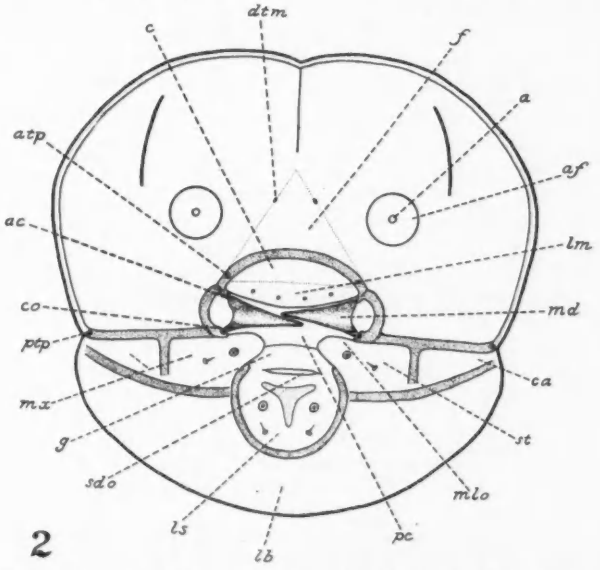

Fig. 2. Front view of typical last-stage larval head of the parasitic Hymenoptera, somewhat diagrammatical, showing external characters.

supporting structure of the head. They also object to several of his terms on the ground that more elegant and technical words are available to designate the structures in question. In particular, the writers prefer the terms hypostoma, pleurostoma (with the superior and inferior pleurostomal rami), and epistoma to designate the thickened ventral margins of the epicranium rather than the "mandibular and labral struts" used by Thorpe to indicate the same thickenings. "Labial ring," as employed by Thorpe, and valuable in the sense that the author used that term, because of the incompleteness of

this thickened structure in generalized forms and a somewhat different interpretation placed on the labial region in general, has been changed to labiostipital sclerome. Stipital and maxillary scleromes have been substituted for Thorpe's "maxillary and labial struts," respectively.

Salt ('31), in a recent work on the parasites of the wheat-stem sawfly *Cephus pygmaeus* Linnaeus, in England, has continued the use of Thorpe's terminology for the head characters

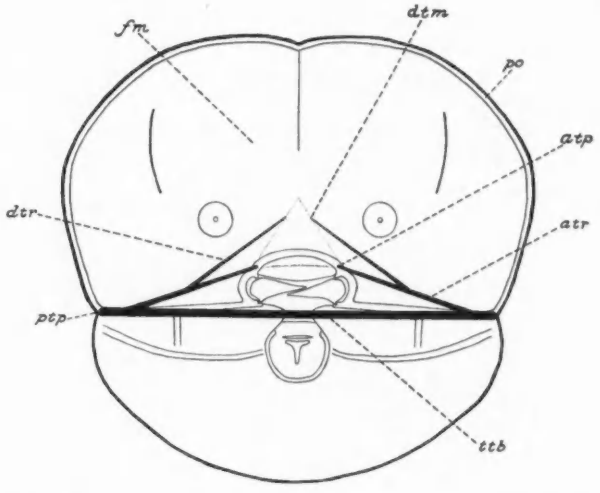

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Fig. 3. Rear view of typical last-stage larval head of the parasitic Hymenoptera, somewhat diagrammatical, showing internal tentorial structures.

of last-stage larvae of the ichneumonids *Hemiteles hemipterus* Fab., *Collyria calcitrator* Grav., and *Pimpla detrita* Holmgr.; of the braconid *Microbracon terebella* Wesm.; and of the chalcid *Pleurotropis benefica* Gahan; and has given good illustrations of the sclerotized head structures in these species.

In their publication on the biology of *Xylonomus brachylabris* Kr. and *X. irrigator* F., two ichneumonid parasites of the larch longhorn beetle *Tetropium gabrieli* Weise, Chrystal and Skinner ('31) have also followed Thorpe's system of nomenclature in their description and illustration of the last stage-larva of *X. brachylabris*.

The accompanying Figures 1, 2, and 3 have been made somewhat diagrammatical in order to present a composite of all characters which might be found on a typical head of a last-stage hymenopterous parasite larva. The abbreviations of the various characters in the drawings are employed in the text without reference to any designated figure. It is to be understood that all structures drawn in the figures and mentioned in the text are not apparent in every larval head; in fact, many of them appear to be entirely absent in some species and only slightly differentiated in others. However, it is the absence or presence of any of the parts, their position or relation to one another, their prominence or degree of thickening or pigmentation, in addition to any sensorial or other head markings, which provide the characters valuable for purposes of determination.

THE PARTS OF THE LARVAL HEAD

The typical larval head of the parasitic Hymenoptera is roughly hemispherical and somewhat flattened dorsoanteriorly. Externally (Figs. 1 and 2), it may be divided into three distinct parts: the superior portion or epicranium; the frontal region or frons; and the inferior or mouth region.

The epicranium is composed of two large identical and symmetrical halves which are separated dorsally and anteriorly by the metopic suture (*ms*) (coronal suture of Snodgrass), extending anteriorly and ventrad in the middle of the head from the postocciput (*po*) toward the median angle of the frons (*f*), and by a line following the lateroventrally directed frontal sutures (*fs*). Ventrally, each epicranial half is bordered by the pleurostoma (*pl*) and hypostoma (*hy*), and posteriorly by the postocciput.

The epicranial regions may be designated as follows: the vertex (*V*), extending from the top of the head anteriorly on either side of the metopic suture (*ms*) to a point about on a level with the anterior extremity of that structure and set off laterally by the temporal fossae (*tf*); the temporal regions (*T*), directly laterad of the vertex where the temporal fossae are located; the antennal regions (*A*), laterad, and sometimes slightly dorsad, of the frontal region (*F*), in which are situated the antennal foramina (*af*); and the genal regions (*G*), or genae, comprising the regions laterad of the frons (*f*), the epistoma (*ep*), and the pleurostoma (*pl*), dorsad of the hypostoma (*hy*), ventrad of the antennal and temporal regions and bounded posteriorly by the postocciput (*po*). Characteristic spines or setae are often apparent on the epicranial regions.

The postocciput (*po*), or posterior border of the epicranium, is a sclerotized band leaving the posterior termination of the hypostoma (*hy*) and continuing dorsally along the posterior border of the epicranium

to the opposite side of the head. The suture differentiating the postocciput from the rest of the epicranium is known as the postoccipital suture (*pos*). Immediately forward of the postocciput lies a region known as the occiput, but this is seldom differentiated in the larvae of the parasitic Hymenoptera and is not an important character.

The temporal fossae (*tf*) are grooves extending ventrally from near the top of the epicranium to points near the antennal foramina (*af*). They indicate the location of the rudimentary eyes. The antennal foramina are round or oval areas which may bear antennal rudiments or short antennae (*a*).

The combined hypostoma (*hy*), *pleurostoma* (*pl*), *and epistoma* (*ep*) form a striking feature of the front of the head, which often appears as a thickened and pigmented, approximately transverse band. The hypostoma extends on each side of the head from the posterior tentorial pit (*ptp*), or lower end of the postocciput (*po*), anteriorly mediad, and often slightly dorsad, to the edge of the preoral cavity (*pc*). On either side of the preoral cavity the hypostoma joins the pleurostoma, at which point is given off a short inferior pleurostomal ramus (*ipr*) usually bearing a slight concavity, the glenoid fossa (*gf*), in which the mandibular condyle (*co*) articulates. The pleurostoma then curves dorsad, and near its other extremity produces another branch, or in some cases only a short spur, the superior pleurostomal ramus (*spr*). This ramus articulates with the mandibular acron (*ac*), the upper basal portion of the mandible (*md*) which is often depressed as a socket. The epistoma begins near the base of the superior pleurostomal ramus and extends over the preoral cavity to a similar point on the opposite side.

The frons (*f*), when differentiated, is a central, roughly triangular, or sometimes rectangular, piece limited laterally by the frontal sutures (*fs*) and anteriorly defined by the epistoma (*ep*). In cases where there is not a clear definition of the sutures, the term frontal region (*F*) is applicable to this portion of the head.

The clypeus (*c*) and *labrum* (*lm*) lie inferior to the frons (*f*) and are bordered dorsally by the epistoma (*ep*). These last two structures are often difficult to separate from each other and the region including them is usually designated as the labrum only. This forms the upper border of the preoral cavity (*pc*), is usually lobed, and may bear several small papillae (*pi*) and lightly pigmented areas.

The mandibles (*md*) are usually well sclerotized and pigmented and lie within the preoral cavity (*pc*). Each may be divided into two parts: (1) the basal portion which is thicker and carries on its outer lower half the condyle (*co*), which articulates in the glenoid fossa (*gf*) of the inferior pleurostomal ramus (*ipr*), and on its upper edge an acron (*ac*), often provided with a depression or socket, which articulates with the superior pleurostomal ramus (*spr*); (2) the longer distal portion narrowing to a free pointed extremity and sometimes bearing numerous teeth on its inner edge.

The two maxillae (*mx*) are raised areas with their lobes (*mlo*) lying on either side of the preoral cavity (*pc*). Exterior to each of the lobes

is a rudimentary palpus (*mpa*) and exterior to this is the maxillary stipes (*st*). The stipes carries one or more setae (*mse*) and is followed, toward the cardo (*ca*), by a sclerotized piece, the stipital sclerome (*sts*), running ventrally from the hypostoma (*hy*) toward the maxillary sclerome (*mas*) and sometimes in a slightly mediad direction. The dorsal border of the maxilla is limited by the hypostoma and the ventral by the maxillary sclerome, which is generally a sclerotized and pigmented piece starting from near the mid-lateral edge of the labiostipital sclerome (*las*) and running laterad and slightly dorsad toward the posterior extremity of the hypostoma.

The glossa (*g*) is the term used for a limited region sloping into the preoral cavity (*pc*) from the orifice of the silk duct (*sdo*), and bordered on either side by one of the maxillary lobes (*mlo*). It is equivalent to the anterior part of the hypopharynx or dorsal surface of the ligula.

The labium, contrary to the common usage of the term in considering the last-stage larval head of the parasitic Hymenoptera, morphologically includes all of that region and those structures lying below the orifice of the silk duct (*sdo*) and maxillae (*mx*), and extending ventrally and posteriorly to the cervical suture. The mid portion of this area, lying just ventrad of the orifice of the silk duct, is usually definitely set off as a round or oval area by a sclerotized and pigmented border, the labiostipital sclerome (*las*). This labiostipital sclerome is usually broken at its dorsal portion, but it may be complete at this point. The ventral part, although generally complete, sometimes terminates in a broadened point which is often only weakly sclerotized and little pigmented. The upper part of the area within this sclerome, just below the orifice of the silk duct and extending ventrad approximately as far as the labial palpi (*lpa*), is taken to be the ligular region (*L*), and is represented in certain species by a thickened, pigmented, triangular or Y-shaped-piece, the ligular sclerome (*lis*). The lower part, on which the labial palpi and setae (*lse*) are located, is called the labiostipites (*ls*).

The labiobase (*lb*) is a large ventral area below the maxillary and labiostipital scleromes (*mas*, *las*) extending posteriorly to the cervical suture. Various spines or setae are sometimes present on this area.

The tentorium (Fig. 3) supports the head internally. From the posterior tentorial pits (*ptp*), located at the posterior extremity of the hypostoma (*hy*) (see also Figs. 1 and 2), or at the lower end of the postocciput (*po*), the transverse tentorial bar (*ttb*) crosses the head internally to a similar point on the other side. In the absence of a fully developed transverse bar, each of its ends may, however, be present as a short spur extending inward from each angle of the postocciput and hypostoma. Near each of the lateral extremities of the transverse tentorial bar, an anterior tentorial ramus (*atr*) may be directed forward and somewhat dorsally to the lateral region of the epistoma (*ep*) to terminate in an anterior tentorial pit (*atp*), and sometimes a slender dorsal tentorial ramus (*dtr*) is given off near the middle of the anterior branch and becomes attached near the dorsal part of the frons (*f*) at the dorsal tentorial mark (*dtm*).

The foramen magnum (*fm*) (occipital foramen of authors) designates the large opening in the posterior part of the head, through which various internal organs enter.

REFERENCES.

Berlese, A. 1909. Gli insetti. Vol. I, Embriologia e morfologia.

Chrystal, R. N. and **Skinner, E. R.** 1931. Studies in the biology of *Xylonomus brachylabris* Kr. and *X. irrigator* F. Parasites of the larch longhorn beetle *Tetropium gabrieli* Weise. Forestry. London; 5: 21–33.

Parker, H. L. 1924. Recherches sur les formes post-embryonnaires des Chalcidiens. Ann. Soc. Ent. France, 93: 261–379.

Salt, G. 1931. Parasites of the wheat-stem sawfly, *Cephus pygmaeus* Linnaeus, in England. Bul. Ent. Res., 22: 479–545.

Snodgrass, R. E. 1928. Morphology and evolution of the insect head and its appendages. Smithsonian Misc. Coll., Vol. 81, No. 3, 158 pp.

Thorpe, W. H. 1930. Observations on the parasites of the pine-shoot moth, *Rhyacionia buoliana* Schiff. Bul. Ent. Res., 21: 387–412.

Yuasa, H. 1922. A classification of the larvae of the Tenthredinoidea. Ill. Biol. Monog., Vol. 7, No. 4, 172 pp.

BOOK NOTICE.

INSECT PESTS OF FARM, GARDEN AND ORCHARD, by E. Dwight Sanderson and Leonard Marion Peairs. (Third edition, revised and enlarged by L. M. Peairs.) Pages i–vii and 1–568, 607 text figures. Published by John Wiley & Sons, Inc., New York. 1931.

This is a revision by Professor Peairs of the well known text in economic entomology. It is in the same general form as the earlier editions and has the material arranged under the following heads: Chapter I. The Injury to Crops by Insect Pests; II. Structure and Development of Insects; III. Insect Control, General, Cultural and Mechanical; IV. Control, Biological; V. Control, Chemical; VI. Control, Methods and Apparatus; VII. Insects Affecting Miscellaneous Garden, Grain and Forage Crops; VIII. Insects Attacking Grasses and Grains; IX. Insects Attacking Clovers and Alfalfa; X. Insects Attacking Beans, Peas, etc.; XI. Insects Attacking Cucurbits, Beets, etc.; XII. Pests of Southern Field Crops; XIII–XVIII. Fruit Insects; XIX. Insects Injurious to Stored Products; XX. Insects Affecting Livestock; XXI. Insects Attacking Poultry; and, XXII. Insects Attacking Man. This volume is of especial value as a text because of its very complete and condensed nature and because the price is within the proper cost range for a student using such a volume for a part of a year. With the continuously changing practices in applied entomology it is as up to date as such a volume can be with the time lost in publishing and the greater time lost between revisions. The continued use of this volume in teaching economic entomology shows that the material is well selected, well arranged and that the book is written with no author prejudice which over-emphasizes some particular phase of the work. We predict that in various revisions it will remain a standard text for some time to come.—C. H. K.

A NEW STRUMIGENYS WITH NOTES ON OHIO SPECIES
(Formicidae: Hymenoptera)

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The genus Strumigenys is a group of small to very minute ants, those in the Ohio fauna averaging about 2 mm. in length for the workers, though some of the more southern forms are more than twice as large. The thirty or forty known species are recorded from all the continents. The records cover Samoa, New Zealand, Australia, New Guinea, Amboina, Ceylon, Japan, Southern Europe, Central and Southern Africa, the Eastern United States, Cuba, Central America and South America to Argentina.[2] Such minute, slow-moving and weak insects must have had eras of time to have spread so widely. It is remarkable that they have retained their generic integrity when spread for so long a time over such a wide and diversified area.

Three species, *pergandei* Emery, *pulchella* Emery and the new one described below, have been taken in Ohio. *Str. dietrichi* Smith, originally described from Mississippi, will probably be found in this state, as it has been taken in southeastern Tennessee and at Urbana, Illinois.

Some of the larger southern species nest under stones, but the four species regional for Ohio nest in rotten logs. In nearly all cases where the log has been identified it has been oak and usually white oak (*Quercus alba* L.). Three specimens of *pulchella* were found by the authors in a log of some softer hard wood in the Huron Bog at Willard, Ohio. The nests have always been found in those parts of the log which have been

[1]The new species was collected by Miss Schramm and the description written by her. Kennedy is responsible for the general and morphological notes, also for the illustrations.

[2]From de Dalla Torre, 1892, Cat. Hymen., Vol. XI; Wheeler, 1922, Distribution of Ants of the Ethiopean and Malagasy Regions, Bull. Amer. Mus. Nat. Hist., 45: 13–37; Mann, 1916, The Ants of Brazil, Bull. M. C. Z., 60: 399–491; Forel, 1900, Biol. Cent. Amer., Hymenoptera 3: 1–169, and Smith, 1931, Revision of the Genus Strumigenys, Ann. Ent. Soc. Amer., 24: 686–710.

continuously moist and which have rotted down to a soft, red punk. When such a log or stump has been located, usually in a woods undisturbed by stock, the collector divests himself of his collecting outfit, seats himself comfortably and prepares to cut up the punky parts of the log with a pocket knife. Otherwise the minute nest may be missed. Usually a half-hour's work will indicate the possibilities. If the ant Proceratium, or some other species of ponerine ant occurs and certain minute beetles are found, the chances are that a nest of Strumigenys occurs in the log. It is then a matter of careful and close work to locate it, as the nests of this ant are thin pockets the width of one's finger and seldom over an inch or two long. The punky material has to be split down to chips one-fourth to one-half inch in thickness. Usually about one nest out of three has been found by discovering only a stray Strumigenys or two and after working through the moist portion of the log and not finding the nest, then reworking the bushel or two of chips. Locating a nest of this ant is seldom a matter of hasty inspection. Usually the careful examination of a log that "looks good" takes the better part of a half day's work and more often than not yields no nest at all. About once a season the collector finds a nest on the first inspection.

In 1931, Kennedy, with a single stroke of the ax, on chopping one more stump before quitting, uncovered a nest of *pergandei* near London, Ohio, at the end of a long day's collecting. This yielded over one hundred workers, the largest nest taken in the state to date. In September, 1932, at Montvale Springs, Blount County, Tennessee, while watching his four-year old son in the hotel swimming pool he pulled a chunk out of a log near by and uncovered the nest of *dietrichi* noted below. The son was rushed into the hotel, the collecting kit procured and after four hours' work seventy-nine workers had been collected. This log had been "passed up" repeatedly on three previous ant collecting trips to Tennessee. The same log yielded a nest of *Ponera trigona opacior* Forel and another oak log near by gave over a hundred males and numerous workers of *Euponera gilva* Roger.

The species of Strumigenys are part of the fauna of the great mass of rotting logs that covered Ohio before the original forest was cleared away. Now these ants are extremely rare, as but a few fragments of these forests remain and such as do usually have had the logs and undergrowth cleared to make

room for stock. The few that are found usually occur in moist ravines or on the edges of swamps. However, none have been found in the very moist hemlock ravines of southern Ohio. They are evidently associated rather with white oak woods, the white oak-chestnut association of ecologists.

Nothing appears to be known of the food habits of the Ohio species. The slender sharply-toothed jaws and the highly developed glossa and maxillary combs suggest that they may be eaters of fungus mycelium. On boiling in KOH they do not show fragments of chitin such as are found in insect-eating ants.

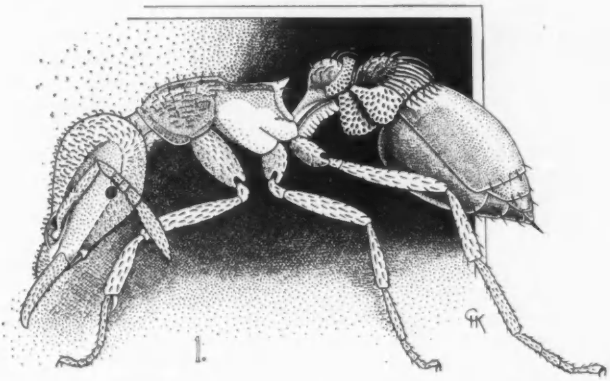


FIG. 1. *Strumigenys ohioensis*, sp. nov., showing the soft, white, fungus-like growths which occur on the petiole in many species of this genus. When boiled in KOH these show a delicate basal structure resembling the pitted surfaces of the other parts of the ant.

The ants of this genus are peculiar in the curious petticoat of soft white tissue which is attached to the petiole and the first segment of the gaster. In our local species these growths are white and look like a spongy fungus. They break down very quickly in KOH. These are shown in Fig. 1. A narrow drape of this hangs down from the underside of the first petiolar segment. A second which is lacy in appearance with its pitted surface is draped about the distal end of this segment, while the largest flounce is from the second segment of the petiole. Usually a narrow band of the same tissue crosses the dorsal side of the anterior end of the gaster. Nothing appears to be known of the structure or function of these parts.

The following is the description of a new species found by Miss Schramm at Tuppers Plains, Meigs County, southeastern Ohio.

Strumigenys ohioensis sp. nov.
(Figs. 1 and 2.)

Worker.—Length, 2 mm.

Head strongly converging anteriorly up to the clypeus. Eyes not visible from the anterior view. Apical border of clypeus rather broadly rounded. In middle of anterior portion of clypeus small smooth prominence. Mandibles dorsoventrally compressed; length about one-fifth of head without clypeus. Prominent acute basal tooth concealed by clypeus; the masticatory border with very little toothless space. The first tooth is rather prominent, the second somewhat smaller followed by a more elongated tooth following which there are four or five gradually diminishing toward apex of mandible. Antennal scapes moderately curved, but not angulate basically.

Thorax with a distinct longitudinal median carina which becomes two carinae at the mesoepinotal constriction diverging to epinotal spines; prothorax slightly flattened dorsally. Epinotal spines short, divergent, directed backward and slightly upward; infraspinal lamellae small and thin. Spongiform processes on posterior and ventral surfaces of petiole and on all of postpetiole except dorsal surface, being most abundant on ventral surface.

Head, thorax, and petiole reticulate-punctate, subopaque. Legs finely punctate. Frontal area of head, plurae of meso- and metathorax and dorsal surface of post-petiole smooth and shining.

Head covered with short curved hairs very slightly enlarged apically. Hairs bordering clypeus short and straight, projecting forward. Hairs on gaster very sparse except on posterior tip, where they are more abundant.

Color ferruginous brown with appendages lighter; gaster approaching black with the exception of the apical tip.

This species is probably closely related to *Strumigenys clypeata* Rogers, but it presents the following differences:

(1) The hairs on the clypeus are short and not spatulate. In *clypeata* they are spatulate and in the varieties, *laevinasis* Smith and *pilinasis* Forel, the clypeal hairs are as long as ⅓–½ the width of the clypeus. In *ohioensis* they are not over ⅛ as long as the width of the clypeus.

(2) The four long teeth on the mandible are more distinct (in greater length) from the apical series of smaller teeth than is shown in Smith's[3] figures of *clypeata*, *laevinasis* and *pilinasis*.

[3]See figs. 9, 11 and 12 in Smith, M. R., 1931, A revision of the genus strumigenys of America, north of Mexico, Ann. Ent. Soc. Amer., 24: 686–710.

In the three species figured in Smith's paper the large basal tooth is probably present but concealed under the clypeus.

(3) The eyes are not visible from the anterior view of the head. But as shown below for *dietrichi*, this may not be a reliable character.

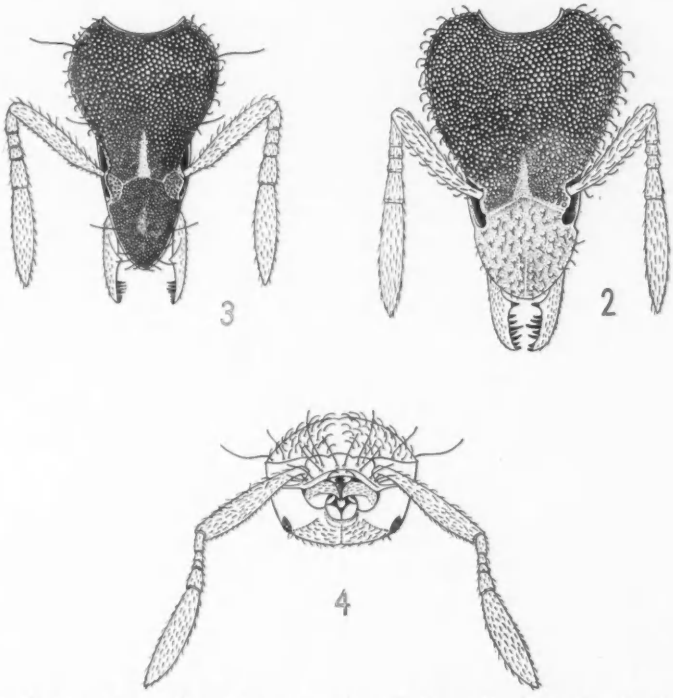


FIG. 2. *Strumigenys ohioensis*, sp. nov., frontal view of head showing the short hairs of uniform length on the clypeus which distinguish this species from *Str. clypeata* Rogers and its varieties which have either spatulate hairs or much longer hairs.

FIGS. 3 and 4. *Strumigenys dietrichi* Smith. 3, Frontal view of head. 4, Face, showing the vibrissae-like clypeal hairs.

Locality: Tuppers Plains, Meigs County, Ohio, M. M. Schramm, collector.

Described from two workers found in partially decayed oak rail embedded in the ground of a dense wooded area bordering a ravine.

Type and cotype to be deposited in the collection of the Museum of Comparative Zoology, Cambridge, Mass.

Notes on Other Species Regional for Ohio.

Strumigenys pergandei Emery.

The literature records this species for Massachusetts, New York, Pennsylvania, Maryland, Virginia, Pelee Island (Lake Erie), Ontario and Illinois. The authors have found this species common on Pelee Island (just north of the Ohio line in Lake Erie) where it occurs in white oak logs in the dense woods on the long sand spit at the south end of the island. This spit is subirrigated by the lake waters and has a high humidity and a mild climate. The mixed hardwood forest, which because of the subirrigation never experiences a dry season, is almost tropical in the luxuriance of its growth. Nests have been taken by Miss Mary Talbot, and the authors. A student, J. R. Gross, collected a few individuals in the Chagrin River gorge southeast of Cleveland. Kennedy collected a large nest (100 workers) in an oak stump at the Shriner's woods south of London, Ohio, in October, 1931, (see above). Miss Schramm records this species from the region around Marietta, Ohio. It is our commonest species and apparently is found over the whole state except in prairie areas and in the wet hemlock gorges.

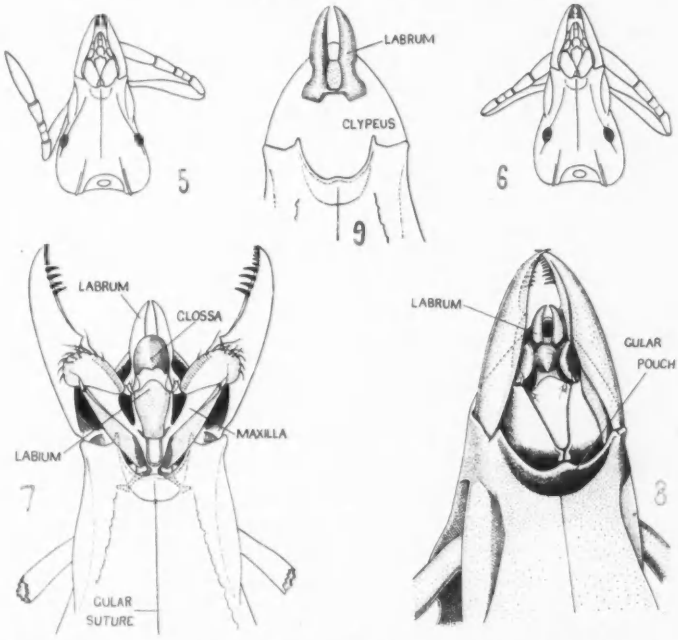
Strumigenys pulchella Emery.

This is another northern species, having been recorded for the District of Columbia, New York, Pennsylvania, Alabama, Mississippi, Illinois and Ohio. The authors collected three workers from a soft wood log in the Huron Bog at Willard, north central Ohio, August 15, 1931. Miss Schramm collected it at Lowell, southeastern Ohio, September 8, 1931, and a student, J. R. Gross, took one specimen in the Chagrin River gorge, southeast of Cleveland, October, 1932. This species is probably distributed over the whole forested area of Ohio, but is so minute that it is difficult to see unless a group of active individuals is uncovered. It appears to be much rarer than *pergandei*.

Strumigenys dietrichi Smith.

This species was described by Doctor M. R. Smith from the region of Lucedale, Mississippi, where it was collected by the coleopterist, Henry Dietrich, who obtained seven specimens

from logs. It has recently been collected by Thomas Park from logs in a woods at Urbana, Illinois. On September 18, 1932, Kennedy found the nest, mentioned previously, in a white oak log on the grounds of the Montvale Springs Hotel, east of Maryville, Tennessee. This hotel is in the western foothills of the Chilhowee Mountains, which is the range just west of the Great Smoky Mountains. It was a large nest 1½ x 1 x ½ inches in size and contained over 80 workers.



FIGS. 5–9. *Strumigenys dietrichi* Smith. 5, Cotype, ventral surface of head, showing the eyes protruding beyond the lateral contour. 6, Tennessee specimen, a minor worker, narrow between the eyes. 7, Ventral view of mouth-parts expanded by KOH. 8, Ventral view of mouth-parts closed. 9, Ventral view of forked labrum attached to underside of clypeus.

The queen was not found and there was little brood. The nest was an ovoid chamber and appeared to connect by minute galleries through the red punky wood to two or three very much smaller chambers four to six inches distant where a few of the total number of workers were taken.

The ants (workers) from this nest checked with Smith's description and with Miss Hoke's figure[4] except for the position of the eyes, which in the type material are visible from the dorsal side of the head as is shown in our Fig. 5. In the first study of the Tennessee material all the specimens examined had the eyes under the head as is shown in our Fig. 6. Doctor Smith examined the Tennessee material and decided it was *dietrichi* and sent the authors a cotype for comparison. Mr. Thomas Park sent a worker of the Urbana, Illinois, material. On comparing these it was noticed that the cotype had the eyes visible from above, the Urbana specimen had the eyes only slightly more underneath the head and that both specimens were darker and slightly larger than the majority of the workers in the Tennessee nest. It was found that the few larger and darker (more robust) individuals of the Tennessee nest had the eyes at the edge of the head or actually protruding beyond the lateral contour. Thus the position of the eyes appears to be a matter of the size and vigor of the worker, the more robust having the eyes farther out from the gular suture.

The Mouth-parts of *Strumigenys* Dietrich.

While making this study the following notes on the structure of the mouthparts of *Strumigenys dietrichi* were made. The parts were boiled in KOH, dissected in glycerine under a binocular at a magnification of 87.8 times. They were then studied under a compound microscope. The figures shown are composites of seventy-six camera lucida sketches. Owing to the minute size few views were obtained *in toto*. The entire insect is only 2 mm. long, the mentum and submentum one two-hundredths of an inch and the labial palp one-thousandth of an inch in length.

The clypeus is the large triangular area in front of the antennal fossae. It has on its apex a group of long hairs that project like vibrissae. See Figs 3 and 4.

The labrum, Fig. 9, is cleft almost to its base, its two prongs usually projecting beyond the apex of the clypeus. The amount of protrusion varies from individual to individual and it was not determined whether the labrum could be thrust forward. In some dissections it appeared to be rigidly attached to the clypeus.

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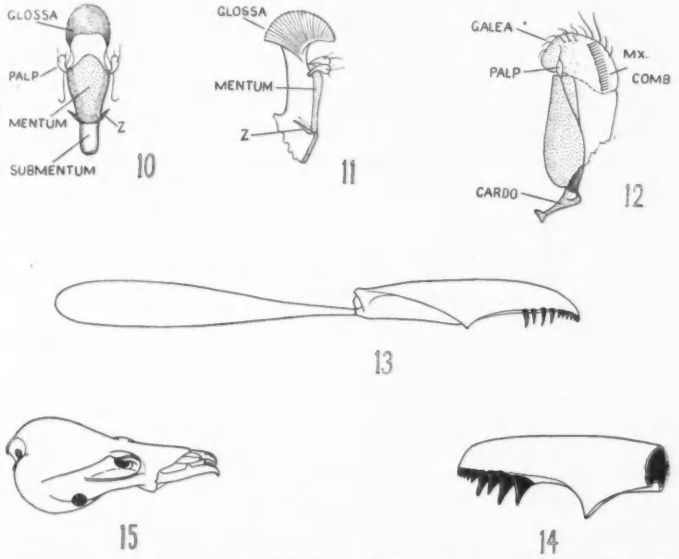
[4]Smith, 1931. Ann. Ent. Soc. Amer., 24, Pl. II, Fig. 6, p. 708.

The mandibles, Figs. 7, 8, and 13, 14, have three types of teeth, a large tooth at mid-length, a group of four long teeth towards the apex and between these and the apex a row of smaller teeth of very uniform length. See Figs. 13 and 14. From above both types of apical teeth appear like slender conical fangs, but a view from the base of the mandible towards the apex shows these to be triangular with their edges up. See Fig. 14. The inner face of the mandible is concave. The mandibular condyles are shown in Fig. 13. The smaller of the two tendons was not found.



FIGS. 10–15. *Strumigenys dietrichi* Smith. 10, Labium, ventral view. 11, Labium, lateral view, showing the one-segmented palp and the chitinous ridges on the glossa or tongue. 12, Right maxilla, flattened out, inner ventral view, showing the one-segmented palp and the maxillary comb of rigid hairs on the galea. 13, Left mandible, dorsal view, showing retractor tendon. 14, Outer half of right mandible, viewed from base, showing the three types of teeth and that the outer teeth are flat and not slender fangs as they appear in Figs. 3 and 13. 15, Craneum, latero-dorsal view, showing antennal fossa.

The maxillae, Figs. 7, 8, and 12, were difficult to figure because they lie in three planes. Fig. 8 shows them closed and in place. Fig. 7 shows them expanded by boiling in KOH. Fig. 12 shows the inside of the right maxilla flattened out. No trace of a lacinia was found. In each dissection were found a pair of maxillary tendons, but always detached from the maxillae, so they were not figured. These were very slender and their bases were joined by a slender bar of about one-third the length of either tendon. This bar may be homologous to

the lorum of the bee mouth parts. See Imms, 1929, General Textbook of Entomology, p. 257, Fig. 510.

The galea has two long hairs on its distal edge, preceded by one to three short hairs and followed by four to six short hairs. On its inner face is a row of very fine hairs which in some dissections appeared as a continuation of the maxillary comb. These varied from two to four in number.

The maxillary comb consists of about 16 rigid hairs lying tight against the inner surface of the galea. In some dissections the comb appeared to be much closer to the inner edge of the galea than as shown in Fig. 12, which is a camera lucida sketch of one dissection.[5]

The maxillary palp is one-segmented with a terminal bristle.

The labium is shown in Figs. 7, 8 and 10, 11. The submentum is a U-shaped bar. The mentum is heavily chitinized. The palps are one-segmented. The glossa is well developed with about 25 fine, sharp ridges running over its surface from side to side. On each lower angle of the mentum is a chitinized prong imbedded in the labial membrane which the author cannot homologize with parts in the mouth-parts of other insects. (Z in Fig. 11.) The lorum of the apidae is a similar prong but is attached at the lower angle of the submentum. It is possible that the parts, Z, are supports of a hypopharynx which was torn away in the dissections. See Donisthorpe, fig. 5, p. 6. Our footnote No. 5. No paraglossae were found.

The gular pouch, Figs. 7 and 8, is a prominent feature of the underside of the head. The bases of the labium and the maxillae can be withdrawn into this to some extent.

The gular suture is a prominent line down the mid-line of the ventral surface of the craneum. See Figs. 4, 5, and 7, 8.

These mouthparts are extraordinarily delicate and yet are used in digging the flat ovoid nest chambers. This is perhaps why these ants are found only in moist and very punky wood. The writer can conceive of no food other than the mycelium of wood infesting fungi which could be used by such delicate organs. No chitinous fragments were found in the bodies of these ants, as appear in the bodies of the ants which feed on other insects, when these are boiled in KOH. No aphids have been found in their galleries. They are an interesting and curious form of ant.

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[5]The best figures of ant mouth parts are those of Janet, 1904, Observations sur les Fourmis, No. 24, figs. 1–7. See also Donisthorpe, 1915, British Ants, pp. 2–16 for terms used.

AMERICAN SPIDERS: ERIGONEAE, MALES WITH CEPHALIC PITS.

C. R. Crosby, Cornell University,
and
S. C. Bishop, University of Rochester.

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In many species of the Erigoneae the males present strikingly grotesque and bizarre secondary sexual characters. These usually take the form of modifications of the head which often becomes enlarged into one or more lobes carrying all or part of the eyes, or a horn may develop on the clypeus or from the median ocular area. These structures are frequently garnished with patches or groups of specialized hairs some of which may be modified into stiff spines of peculiar form.

Among the most interesting and puzzling of these secondary sexual characters are the structures known as cephalic pits. These deep conical pits with nearly circular openings are usually placed just back of and a little above the posterior

lateral eyes, although their exact position varies considerably with the species. These cavities are often so deep that the pits from the opposite sides of the head almost meet in the median line. The opening of the pit usually lies in the anterior end of a groove extending backward along the side of the head from a point near the posterior lateral eye. There is considerable variation in depth and shape of this groove and in its position; sometimes it is almost absent.

We have been unable to find anything written on the function of the cephalic pits except what is contained in W. S. Bristowe's highly interesting account of the copulation of *Hypomma bituberculata* Wider (Proc. Zool Soc. Lond., 1931, p. 1404). From his observations it is evident that during copulation the female seizes the male by the head and apparently the claws of her chelicerae are inserted into the cephalic pits.

It is a question whether cephalic pits have arisen more than once in the phylogeny of the Erigoneae. While it is quite probable that such is the case, we have decided to treat the American species having this character as a group although we are aware that some of the species may have close affinities with others lacking cephalic pits. The problem of determining the relationships of the species in this group is furthermore complicated by the probability that in some cases the pits have been lost. This seems to be true in *Ceratinops rugosa* Em.

No serious attempt has been made in the past to place the American species of this group in the proper genera. Emerton and Banks have described most of the species, placing them usually in Lophocarenum. Influenced by Simon, Crosby (1905) transferred most of the species to Diplocephalus. The type species of this genus, however, does not have cephalic pits and our species are only distantly related to it. In attempting to place our species we have studied the type species of most of the European genera having cephalic pits. The type species of the following exotic genera have not been available for study.

Abacoproeces Simon.
Erigone saltuum L. Koch.

Ostearius Hull.
Tmeticus nigricauda Cambridge.

Plaesianillus Simon.
Erigone cyclops Simon.

Troxochrota Chyzer and Kulczynski.
Troxochrota scabra Chyzer and Kulczynski.

Centromerus Dahl.
Micryphantes aequalis C. L. Koch.

Atypena Simon.
Atypena superciliosa Simon.
Zilephus Simon.
Zilephus granulosus Simon.
Hypselistoides Tullgren.
Hypselistoides affinis Tullgren.
Saloca Simon.
Walckenaera dioceros Cambridge.

The spiders having cephalic pits may be divided into two groups on the basis of the presence of hardened sclerites on the abdomen. We have placed the species having these sclerites in the genus Pelecopsis.

Pelecopsis Simon.

Hist. Nat. Ar. Ed. I., p. 196. 1864.

Type: *Micryphantes inaequalis* C. L. Koch.

We revised this genus in 1931 (N. Y. Ent. Soc. Jour. 39: 381–388). It includes *excavatum* Em., *moestum* Banks, and *sculptum* Em.

In all other American species the abdomen has a soft integument.

In the two lists that follow, we have indicated the present disposition of the species which have been placed in Lophocarenum and Diplocephalus. We have been unable to place, with any degree of certainty, several species described from females only.

THE PRESENT DISPOSITION OF THE SPECIES DESCRIBED UNDER LOPHOCARENUM.

abruptum Emerton (1909) placed in Mythoplastoides.
arenarium Emerton (1911) placed in Minyriolus.
arvensis Banks (1892) equals *Cornicularia communis* Em.
castaneum Emerton (1882) placed in Minyriolus.
coriaceum Emerton (1913) equals *Pelecopsis moestum* Banks.
crenatoideum Banks (1892) equals *Ceratinops crenata* Em.
crenatum Emerton (1882) placed in Ceratinops.
cuneatum Emerton (1909) placed in Chocorua.
bicarinatum Emerton (1913) (no pits).
decemoculatum Emerton (1882) placed in Dismodicus.
dentipalpis Emerton (1915) placed in Hybocoptus.
depressum Emerton (1882) placed in Lophomma.
domiciliorum Emerton (1911) equals *Aulacocyba subitanea* Cambr.
erectum Emerton (1915) placed in Mythoplastoides.
erigonoides Emerton (1882) placed in Eridantes.
excavatum Emerton (1911) placed in Pelecopsis.
exiguum Banks (1892) placed in Mythoplastoides.
fasciatum Banks (1904) placed in Tortembolus.
flagellatum Emerton (1911) placed in Tapinocyba.

formosum Banks (1892) equals *Eridantes erigonoides* Em.
frontalis Banks (1904) placed in Pelecopsidis, new genus.
hartlandianum Emerton (1913) placed in Pocadicnemis.
hortense Emerton (1924) placed in Tapinocyba.
inflatum Emerton (1923) placed in Ceratinops.
latum Emerton (1882) placed in Ceratinops.
littorale Emerton (1913) placed in Ceratinops.
longior Banks (1892) equals *Cornicularia directa* Cambr.
longitubum Emerton (1882) equals *Pocadicnemis pumila* Blackw.
longitarsum Emerton (1882) placed in Baryphyma.
miniakianum Emerton (1919) equals *Pelecopsis excavatum* Em.
miniatum Banks (1892) equals *Cornicularia directa* Cambr.
minutum Emerton (1909) placed in Tapinocyba.
minimum Emerton (1923) placed in Symmigma.
montanum Emerton (1882) equals *Minyriolus castaneus* Em.
montiferum Emerton (1882) placed in *Oedothorax*.
parvum Banks (1892) equals *Eridantes erigonoides* Em.
pallidum Emerton (1882) placed in Cochlembolus.
quadricristatum Emerton (1882) placed in Horcotes.
rostratum Emerton (1882) placed in Origanates.
rugosum Emerton (1909) placed in Ceratinops.
rotundum Emerton (1925) (no pits).
scopuliferum Emerton (1882) placed in Tapinocyba.
sculptum Emerton (1917) placed in Pelecopsis.
simplex Emerton (1882) placed in Tapinocyba.
sylvaticum Emerton (1913) placed in Lophomma.
tristis Banks (1892) described from ♀, cannot be placed.
unimaculatum Banks (1892) described from ♀, probably *Hypselistes florens* Cambr.
vaccinii Emerton (1926) placed in Lophomma.
venustum Banks (1892) equals *Gonatium rubens* Blackw.
vernale Emerton (1882) placed in Cochlembolus.

THE PRESENT DISPOSITION OF THE SPECIES DESCRIBED UNDER DIPLOCEPHALUS.

carolinus Banks (1911) placed in Ceratinops.
castigatorius Crosby (1905) equals *Tortembolus fasciatus* Banks.
crumbi Petrunkevitch (1925). We examined the type of this species and found that it equals *Mimognatha foxi* McCook. This species has had an interesting history. At present its synonymy stands as follows:

Theridium foxi McCook, Amer. Spiders, Vol. 3, Pl. 29, Fig. 1, 1893.
Mysmena bulbifera Banks. Amer. Ent. Soc. Trans. 23: 66, 1896.
Mysmena bulbifera Simon. Hist. Nat. Ar. 2: 991, 1903.
Mysmena bulbifera Banks. Phila. Acad. Nat. Sci. Proc., 1904, p. 127, Pl. 7, Figs. 12–13.
Glenognatha bulbifera Barrows. Ohio Jour. Sci. 19: 210, Figs. 1–2, 1919.
Glenognatha foxi Crosby. Can. Ent. 57: 50, 1925.
Diplocephalus crumbi Petrunkevitch. N. Y. Ent. Soc. Jour. 33: 171, Pl. 8, Figs. 1–2, 1925.
Mimognatha foxi Banks. Mus. Comp. Zool. Bul. 69: 90, 1929.

cryptodon Chamberlin (1920) equals *Zornella cultrigera* Koch.
gloriae Petrunkevitch (1930) from Puerto Rico, should be placed in Mimognatha.
wamotsus Chamberlin (1919) equals *Hybocoptus dentipalpis* Em.

Keyserling (Spinnen Am. Therid. 2: 148, Pl. 6, Fig. 215, 1886) described *Erigone polaris* from Alaska. The male seems to have cephalic pits. No specimens were available for study.

Ceratinops Banks.

Am. Nat. 39: 309. 1905.

Type: *Ceratinella annulipes* Banks.

In this genus we place seven closely related species, in six of which the males have cephalic pits and in one they do not. In other characters they are very similar: the embolic division is very simple, consisting of a thin, nearly flat tail-piece, which gives rise directly to a very short, nearly straight, embolus, except in *crenata*, where there has developed a large ventral branch; the tegulum is greatly developed and protuberant ventrally; the dorsal margin of the tibia of the palpus is broadly truncate or at least not armed with a long process; the cephalothorax is coriaceous and rugose, especially along the radiating lines, but to a lesser extent in *carolina* than in the other species; the sternum is more or less produced between the coxae of the first and second and to a less extent between the second and third legs; the epigynum is of the type shown in the figures. In regard to the cephalic pits it seems most reasonable to suppose that they have been lost in *rugosa*. In *crenata*, *inflata*, *carolina* and *lata* they are well developed and in the normal position back of the posterior lateral eyes; in *littoralis* they are close above these eyes while in *annulipes* they have migrated to a position midway between the posterior median and lateral eyes and have become smaller; in *rugosa* they are absent.

KEY TO THE SPECIES OF CERATINOPS, MALES.

1. Without cephalic pits. (Page 116)..... **rugosa**
   With cephalic pits..... 2
2. Embolic division with a large, ventral branch, Y-shaped. (Page 111), **crenata**
   Embolic division not of this form..... 3
3. Cephalic pit behind the posterior lateral eye; cephalic lobe high..... 4
   Cephalic pit above the posterior lateral eye..... 5
4. Cephalothorax coarsely rugose; embolus single at tip. (Page 113).... **inflata**
   Cephalothorax finely or not at all rugose; tip of embolus double. (Page 111)..... **carolina**
5. No definite cephalic lobe present. (Page 109)..... **annulipes**
   A definite cephalic lobe present..... 6
6. Dorsal margin of tibia of palpus broadly truncate. (Page 115)..... **littoralis**
   Dorsal margin of tibia produced into a broad, rounded lobe. (Page 114)... **lata**

Ceratinops annulipes Banks.

(Plate I, Figs. 1–5.)

Ceratinella annulipes Banks. Phila. Acad. Nat. Sci. Proc. 1892, p. 33, Pl. 2, Fig. 56.
Ceratinops annulipes Banks. Am. Nat. 39: 309. 1905.
Ceratinops annulipes Banks. Phila. Acad. Nat. Sci. Proc. 1916, p. 72.
Lophocarenum latum Crosby and Bishop. N. Y. State Mus. Bul. 264: 11. 1925.

Male.—Length, 1.1 mm. Cephalothorax dark brown, the surface rugose with impressed radiating lines; head smooth. Cephalothorax viewed from above rather broad, slightly crenulate on the sides posteriorly, sides rather strongly convergent towards the front with a slight constriction at the cervical groove, nearly straight across the front, the eyes being in profile. No definite cephalic lobe. The cephalic pits visible from above between the posterior median and lateral eyes. Cephalothorax viewed from the side steeply ascending behind and rounded over the back, nearly level on top, no depression at the cervical groove. Clypeus gently convex, nearly vertical.

Posterior eyes in a procurved line, the median separated by the diameter and from the lateral by one and one-half times the diameter. Cephalic pit small, round and situated between the posterior median and lateral eyes. Anterior eyes in a straight line, the median nearly the same size as the lateral, separated by a little more than the radius and a little farther from the lateral. Sternum strongly convex, rugose, the ridges black over dark orange, produced behind as a broad inflexed point wider than the length of coxa. Labium nearly black. Endites and chelicerae dusky orange. Legs and palpi yellow-orange, patellae light. Abdomen black.

Femur of palpus gently curved inward and gradually widened distally. Patella rather thick, curved downward. Ratio of length of femur to that of patella as 10 to 4. Tibia longer than patella, gradually widened distally; the dorsal margin produced into a broad rounded lobe with a minute black tooth on the lateral angle and with the lateral notch broad and shallow, evenly rounded. Paracymbium rather slender, strongly curved. Tegulum greatly developed, strongly convex and covering the greater part of the ventral side of the bulb. Bezel high, edge rounded, blackish. The embolic division small, lying across the end of the bulb. It consists of a small, broad, rounded tail-piece, the ventral edge of which is minutely dentate; distally it ends in an oblique ridge beneath which arises the short flattened embolus; the ejaculatory duct opens on the dorsal angle and the ventral angle in thin and rounded but when viewed sidewise appears as a slender black tooth. The median apophysis ends in a black tooth near the embolus.

Female.—Length, 1.3 mm. Similar to male in color. The thorax is smoother than in the male and the margin not so strongly crenulate. Posterior eyes in a slightly procurved line, the median separated by two-thirds the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median a little smaller than the lateral, subcontiguous and separated from the lateral by the radius of the median. The epigynum consists of a rounded convex plate. The middle lobe is elongate, wider behind and constricted in the middle.

Type locality: Not given, but doubtless near Ithaca, N. Y.

New York: McLean, May 16, 1925, 2♂, May 14, 1919, 3♂ 3♀ (sifted from moss in bog); Cranberry Creek, August, 1911, 1♂ (Emerton det.); Poughkeepsie, 1♂ (Banks).

Ceratinops carolina Banks.

(Plate I, Figs. 6–9.)

Diplocephalus carolinus Banks. Phila. Acad. Nat. Sci. Proc. 1911, p. 447, Pl. 34, Fig. 2.

Male.—Length, 1.5 mm. Cephalothorax orange-yellow, strongly suffused with dusky, lighter on the cephalic lobe; viewed from above evenly rounded on the sides without any constriction at the cervical groove, bluntly rounded in front. The cephalic lobe with the sides parallel, abruptly widened opposite the median eyes, squarely truncate in front. Cephalothorax viewed from the side rather steeply ascending behind to the cervical groove, then arched over the head to the posterior median eyes. The front of the cephalic lobe clothed with stout hairs curved downward, strongly convex and overhanging, cut off below by transverse groove. Clypeus slightly convex and protruding.

Sternum orange-yellow, finely reticulate with dusky, much darker at the margin. Labium and endites lighter. Legs bright orange-yellow; patella much lighter. Abdomen dark gray.

Posterior eyes in a procurved line, the median larger than the lateral and separated by twice the diameter and from the lateral by four times the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by three times the radius. Cephalic pit placed back of and above the posterior lateral eye in a very deep, broad groove.

Femur of palpus rather long, slender and nearly straight; patella long and slightly widened distally. Ratio of length of femur to that of patella as 22 to 11. The tibia has the dorsal margin broadly produced, terminating on the mesal corner in a sharp angle and laterally in a rounded lobe, the intervening margin gently concave. The lateral margin of the mesal projection armed with a low, blunt, tooth. Paracymbium stout and strongly curved. Tegulum strongly protuberant ventrally, the bezel very high, edge smooth. The tail-piece of the embolic division thin, flat, rounded at tip, the tip extending to the edge of the tegulum. The embolus rather short, stout, black and acutely pointed. The median apophysis appears as a black, curved, stout process that lies laterally from the embolus.

Type locality: Black Mountain, N. C.

North Carolina: Aquone, October 16, 1926, 1♂; Black Mt., 1911, 1♂.

Ceratinops crenata Emerton.

(Plate I, Figs. 10–16.)

Lophocarenum crenatum Emerton. Conn. Acad. Sci. Trans. 6: 51, Pl. 14, Fig. 7, 1882.
Lophocarenum crenatoideum Banks. Phila. Acad. Nat. Sci. Proc. 1892, p. 37, Pl. 4, Fig. 8.
Diplocephalus crenatus Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus crenatus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 304.
Diplocephalus crenatoideus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 304.
Diplocephalus crenatus Banks. Phila. Acad. Nat. Sci. Proc. 1916, p. 74.

Male.—Length, 1.8 mm. Cephalothorax dark chestnut brown with darker radiating lines; the surface distinctly rugose except on the head. Cephalothorax viewed from above rather long, evenly rounded on the sides to the cervical groove, where there is a slight constriction, rounded across the front; the cephalothorax behind the cervical groove distinctly crenate, the four lobes corresponding to the coxae. Posteriorly the cephalothorax is produced into a distinct rugose neck for the attachment of the abdomen. Viewed from above the cephalic lobe is narrower in front than behind and bears the posterior median eyes some distance from the front. Cephalothorax viewed from the side gently rounded to the cervical groove, then more steeply ascending and arched over the head to the posterior median eyes, then slanting down in a straight line to the anterior median eyes. Clypeus broad, straight and slightly retreating. Cephalic pit small and round, situated just behind the posterior lateral eye in a shallow groove.

Posterior eyes in a procurved line, the median separated by slightly more than the diameter and a little farther from the lateral. Anterior eyes in a slightly procurved line, the median smaller than the lateral, very close together on a black spot and separated from the lateral by the radius.

Chelicerae small and retreating. Sternum strongly convex and strongly rugose; the ridges blackish over reddish. Coxal cavities all closed and separate. Hind coxae separated by about the length. Labium same color as sternum. Endites dusky. Legs orange-yellow. Palpi much darker. Abdomen dark gray, nearly black. Epigastric plates orange.

Femur of palpus gently curved inward and upward, gradually thickened distally. Patella short, nearly as thick as femur. Ratio of length of femur to that of patella as 22 to 9. Tibia longer than patella, much widened distally; the dorsal and mesal margin thin and semi-transparent; the dorsal margin gently rounded on the mesal half and laterally with a shallow rounded excavation; the dorsal apophysis represented by a nearly right angle turn in the margin at the inner edge of the excavation. Cymbium with a groove parallel with the lateral margin. Paracymbium small, slender and strongly curved. Tegulum strongly developed, rounded; the bezel has the margin nearly straight and blackish. The embolic division consists of a short, flat, rounded basal part corresponding to the tail-piece and two branches; the terminal branch is rounded at tip and the ejaculatory duct opens through a short spur on the inner side just below the tip; the other branch is curved, pointed, and lies free over the edge of the tegulum. The median apophysis appears as a thin, broad-tipped process with a sharp, black point on the corner next to the cymbium.

Female.—Length, 1.9 mm. Similar to male in form and color. Posterior eyes in a slightly procurved line, equidistant, separated by the diameter. Anterior eyes in a procurved line, the median much smaller than the lateral, separated by two-thirds the diameter and about the same distance from the lateral. Head nearly as high as in the male but without pit or furrow. Palpi with the last two segments darker than the others and greatly thickened. Epigynum rather high in front.

The middle lobe paler than the sides, extending from the front to the hind margin, narrow in front, broad behind with the sides constricted at the middle and again nearer the front.

Type localities: Beverly, Mass., and New Haven, Conn.

Massachusetts: Readville, November, 1918, 1 ♀ (Emerton); Woods Hole, July, 1919, 2 ♀ (Forbes). *Connecticut:* New Haven, October, 1881, 1 ♂ (Emerton); October 18, 1902, ♂ (Bryant). *New York:* Woodworth Lake, Fulton Co., August; Ithaca, August, 1 ♂ (on side walk); Ithaca, 1 ♀ (determined by Banks as *crenatoideum*); Sea Cliff, June 13, 1919, 1 ♀ (on sand beach); Cold Spring Harbor, July 13, 1907, ♂ ♀, August, 1907, 1 ♀ (Bryant). *Virginia:* Falls Church, Banks ♀. *Missouri:* Columbia, November, 1904, 1 ♀. *Kansas:* Manhattan, June-October, 1923, 1 ♀ (R. C. Smith). *Florida:* Newnan's Lake, Gainesville, February 3, 1927, 2 ♂, 7 ♀ (Barrows). *Louisiana:* Shreveport, ♂ (Banks). *Washington:* Friday Harbor, June-July, 1928, 1 ♂, 1 ♀ (Shackleford).

Emerton records the species from Chelsea, Que.; Grand Beach, Lake Winnipeg.

Ceratinops inflata Emerton.

(Plate I, Figs. 17–21.)

Lophocarenum inflatum Emerton. Can. Ent. 55: 243, Fig. 9, 1923.

Male.—Length, 1.8 mm. Cephalothorax dusky orange-yellow, viewed from above evenly and broadly rounded on the sides with a very slight constriction at the cervical groove, very broadly rounded across the front. Cephalic lobe with the sides nearly parallel and slightly concave, broadly rounded across the front. Cephalothorax viewed from the side rather steeply ascending behind, then gradually ascending to the base of the head, evenly arched over the head, the front with a notch above the anterior median eyes. Clypeus nearly straight, slightly protruding. Cephalic pit back of the posterior lateral eyes in the anterior end of a narrow groove.

Posterior eyes in a slightly recurved line, the median slightly larger than the lateral, separated by three times the radius and from the lateral by three times the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, subcontiguous, separated from the lateral by a little more than the diameter.

Sternum dusky orange-yellow, very broad, convex, finely rugulose. Endites dusky orange-yellow, tip whitish. Legs orange. Abdomen gray.

Femur of palpus moderately long, curved inward and widened distally. Patella long, rather slender, widened distally. Ratio of length of femur to that of patella as 32 to 15. Patella and tibia together as long as femur. Tibia rather long, the distal part thin, semitransparent and broadly produced over the base of the cymbium, the distal margin laterally, broadly and evenly rounded, mesally with a shallow, rounded excavation, the mesal side nearly straight. The lateral margin

of tibia armed with a row of seven long, stiff hairs. Paracymbium very strongly curved with a very shallow notch before the tip, armed at base with five or six small, stiff hairs. Tegulum greatly developed and protuberant ventrally; the bezel thin and finely denticulate.

The embolic division consists of a thin, flat, nearly straight tail-piece widened at the middle, which gives rise directly to a black, sharply pointed, slightly curved embolus; the median apophysis appears as a small, black, sharp-pointed tooth near the tip of the cymbium.

Female.—Length, 2.5 mm. Similar to the male in color, the head normal. Posterior eyes in a slightly procurved line, the median larger than the lateral, separated by two-thirds the diameter, and from the lateral by a little more. Anterior eyes in a straight line, the median smaller than the lateral, separated by a little less than the radius and from the lateral by the diameter. The epigynum has the middle fovea long, a little broader behind than in front, constricted at the anterior third.

Type locality: Terrace, B. C.

Washington: Longmire, August 22, 1927, 3♂, 9♀.

Ceratinops lata Emerton.

(Plate I, Figs. 22–28.)

Lophocarenum latum Emerton. Conn. Acad. Sci. Trans. 6: 50, Pl. 14, Fig. 4. 1882.
Diplocephalus latus Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus latus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 305.

Male.—Length, 1.8 mm. Cephalothorax brownish over orange, rugulose; the impressed radiating lines less distinct than in *annulipes* and *littoralis;* head smooth. Cephalothorax viewed from above broad, evenly rounded on the sides, margin not crenulate, only a very slight constriction at the cervical groove, broadly rounded across the front, the eyes in profile; cephalic lobe short, the sides convergent towards the front. Cephalothorax viewed from the side broadly rounded over from the posterior margin to the posterior eyes; the median ocular area sloping steeply forward; clypeus gently convex and protruding. Cephalic pit very small, round, situated midway between the posterior median and lateral eyes in the anterior end of a shallow groove.

Posterior eyes in a procurved line, the median slightly larger than the lateral, separated by the diameter and from the lateral by a little more than twice the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by less than the radius and from the lateral by the diameter.

Sternum rugose, broad, convex, dull orange with the ridges and margin darker. Posterior coxae separated by the length. Endites dull orange-yellow. Legs orange-yellow, patellae lighter. Abdomen dark gray, almost black.

Femur of palpus rather stout, curved inward and gradually widened distally. Patella short, curved downward. Ratio of length of femur to that of patella as 15 to 7. Tibia short, greatly widened distally. Dorsal margin produced dorsally into a broad rounded lobe which is

deeply excavated on the side, the posterior margin of the excavation with a row of long hairs. Tegulum strongly developed, the margin blackish. The embolic division small and lying diagonally across the end of the bulb; the tail-piece broad, thin, flat, and pointed, terminating in a short pointed process, the embolus. The median apophysis appears as a short black tooth back of the embolus.

Female.—Length, 1.5 mm. Similar to the male in form and color. Posterior eyes in a slightly procurved line, equal, the median separated by the diameter and a little farther from the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by less than the radius and from the lateral by the radius. The epigynum consists of a quadrate plate with rounded corners. The middle lobe squarish behind, narrow in front, the confining walls parallel posteriorly, concave and convergent anteriorly.

This species is closely related to *annulipes* and *littoralis* but is larger. In the male the thorax is smoother and the margin is not crenate; the embolic division is slightly different.

Type locality: Watertown, Mass.

Massachusetts: Watertown, March 10, 1875. 1 ♂. *Missouri:* Columbia, May, 1905. 1 ♂, July, 1 ♀. *Mississippi:* Lucedale, January 1, 1930, 3 ♂, 1 ♀. (Dietrich).

Ceratinops littoralis Emerton.

(Plate II, Figs. 29–34.)

Lophocarenum littorale Emerton. Am. Mus. Nat. Hist. Bul. 32: 256, Pl. 48, Fig. 2, 1913.

Male.—Length, 1.5 mm. Cephalothorax dark mahogany brown, rugose with impressed radiating lines; head smooth, lighter. Cephalothorax viewed from above rather broad, rounded on the sides with the sides convergent toward the front, slightly crenulate posteriorly; the eye-area wider than margin of cephalothorax and anterior eyes in profile. Cephalic lobe with the sides a little convergent in front, the sides nearly straight. Cephalothorax viewed from the side evenly rounded over the back to the posterior median eyes without any depression at the cervical groove, nearly level on top of head. A distinct depression between the posterior median and anterior median eyes. Cephalic pit white, just above the posterior lateral eye and in line with the posterior median. Viewed from in front the cephalic lobe constricted on each side with a triangular notch at the cephalic pit.

Posterior eyes in a slightly procurved line, the median placed close to the front margin of the cephalic lobe, separated by the diameter and from the lateral by more than twice the diameter. Anterior eyes in a straight line, the median a little smaller than the lateral, separated by half the radius and from the lateral by a little more than the diameter.

Sternum convex, rugose with the ridges black over reddish orange, broad behind between the coxae which are separated by more than the length. Endites grayish reddish orange. Legs and palpi yellow-orange. Abdomen nearly black.

Femur of palpus gently curved inward. Patella curved downward. Ratio of length of femur to that of patella as 15 to 7. Tibia longer than patella, gradually widened distally, the dorsal margin broadly produced forward, nearly straight across with the angles rounded and a minute black tooth on the lateral angle (not visible in full dorsal view); lateral excavation broad, shallow, and rounded. Paracymbium rather slender, strongly curved, hooked at tip. Tegulum very large, convex, covering a large part of the ventral surface of the bulb. Bezel nearly straight across edge, blackish. The embolic division is very similar to that of ***annulipes*** and consists of a small, broad, rounded tail-piece, the edge of which is minutely dentate. It ends in a short black point through which the ejaculatory duct opens and which has a semi-transparent flange on each side. The median apophysis is a small black tooth.

Female.—Length, 1.6 mm. Similar to male in form and color. Posterior eyes in a procurved line, the median separated by two-thirds the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous and separated from the lateral by the diameter. Epigynum similar to that of ***annulipes***, but the posterior part of the middle lobe is narrower.

Type locality: Cold Spring Harbor, N. Y.

New York: Riverhead, beach of Long Island Sound, September 10, 1922, many ♂ and ♀ under shade of plants on sand; Cold Spring Harbor, August, 1907, 9 ♂, 9 ♀, (Bryant).

Ceratinops rugosa Emerton.

(Plate II, Figs. 35–39.)

Lophocarenum rugosum Emerton. Conn. Acad. Sci. Trans. 14: 191, Pl. 2, Fig. 3. 1909.

Male.—Length, 1.6 mm. Cephalothorax chestnut brown; head smooth; thorax roughened with radiating wrinkles. At the posterior margin, at the insertion of the pedicel there is a distinct, though shallow, transverse groove which is crossed by many short ridges. Viewed from above the cephalothorax not evenly rounded on the sides, rather squarish behind, widest just back of the middle from which point the sides converge towards the front and rear, nearly straight across the front where the anterior eyes are seen in profile; viewed from the sides gently and evenly arched over the back to the posterior eyes. Clypeus straight and nearly vertical.

Posterior eyes in a procurved line, equal, the median separated by two-thirds the diameter and a little farther from the lateral; the median much higher on the head than the lateral. Anterior eyes in a gently procurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by the diameter.

Sternum reddish brown, strongly convex, and rather coarsely rugose. At the sides the sternum extends between the coxae. Posteriorly it ends in a broad, truncate, inflexed point. Hind coxae separated by a little more than the length. Pedicel strongly chitinized,

tubular, the anterior margin provided with a strong flange below. Labium same color as sternum. Endites orange-yellow suffused with gray. Legs and palpi orange-yellow, patella pale. Anterior tarsi distinctly fusiform; those of the second legs less so.

Abdomen gray, ovate, without a dorsal sclerite, in alcohol marked with fine light lines. Epigastric plates orange-yellow, widely separated by soft integument; each plate bordered laterally by a chitinized area which extends back of the epigastric furrow into a rounded angle. Spiracular furrow with a small orange chitinized area on each side.

Femur of palpus strongly curved inward; patella rather short but about as thick as femur. Ratio of length of femur to that of patella as 15 to 6. Tibia longer than patella, widened distally; the dorsal margin thin, produced over the base of the cymbium in a broad lobe with a smooth regular edge. The distal lateral angle is truncate and bears one or two obscure teeth under the edge. The lateral notch large and regularly rounded. Just back of the margin of the notch there is a row of stiff hairs. Paracymbium small, curved in a semicircle, the base hairy. Bezel very large, forming the most conspicuous part of the bulb, the edge curving in a semicircle around the embolus. Embolic division consists of a short, flat, slightly curved tail-piece which lies on the side of the end of the bulb. Embolus a short, curved, blackish process arising directly from the end of the tail-piece, about as long as the width of the latter. The median apophysis appears as a short, sharp black tooth lying just back of the embolus.

Female.—Length, 1.5 mm. Similar to the male in form and color. Abdomen more distinctly streaked with light lines and therefore appears lighter than in male. Tibia and tarsus of palpus long and robust, distinctly thickened. Epigynum has the middle lobe nearly square behind but constricted by the openings on each side in front.

Type localities: Grafton, Mass., and Three-mile Island, Lake Winipesaukee, N. H.

New York: Juanita Island, Lake George, August 5, 1920, 5 ♂, 10 ♀ (sifting); Baiting Hollow, May 31, 1923, 1 ♀. *Florida:* Dunedin, December, 1925, 1 ♀ (Blatchley). *Missouri:* Columbia, October, 2 ♀. *Illinois:* Urbana, October 24, 1925, 1 ♂ (Smith).

Tapinocyba Simon.

Ar. Fr. 5: 778. 1884.

Type: *Walckenaera praecox* Cambridge.

The following notes on *T. praecox* are based on specimens from France determined by Simon.

Male.—Cephalothorax viewed from above evenly rounded on the sides, the margin very slightly crenulate, without constriction at the cervical groove, broadly rounded across the front. Cephalic ridges nearly parallel, slightly convex. Cephalothorax viewed from the side rather steeply ascending behind and then evenly and broadly arched

over the head to the posterior median eyes. Clypeus slightly convex, nearly vertical. Cephalic pit small, round and placed just above and back of the posterior lateral eye in the anterior end of a narrow groove. Sternum broad and convex, nearly smooth, not produced laterally between the coxae.

Posterior eyes in a procurved line, equal, the median separated by the diameter and a little farther from the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by a little less than the radius and a little farther from the lateral. Femur of palpus moderately long and stout, slightly curved inward. Patella short, stout, and straight. Ratio of length of femur to that of patella as 13 to 6. Tibia short, viewed from above with the sides straight, wider distally, the dorsal margin produced in the middle into a pointed triangular tooth, laterally from this tooth the margin is shallowly excavated with a row of stiff hairs just back of the margin. Tegulum greatly developed and protuberant ventrally. The embolic division consists of a thin, flat, oval tail-piece which gives rise directly to a short, rather stout embolus with the sides parallel and the tip slightly incurved. The median apophysis appears as a minute, dark, pointed tooth close to the edge of the cymbium.

Female.—Similar to male in form and color. The epigynum has a transverse fovea on the posterior margin and is biconvex in front.

We have placed in Tapinocyba five species that are evidently closely related to each other and to *T. praecox* especially in the form of the embolic division of the bulb. It is true that there is considerable variation in the form of the head and of the tibial apophysis in these species, but it seems best to keep them together for the present at least.

KEY TO THE SPECIES OF TAPINOCYBA, MALES.

1. Tibia broadly produced over the base of the cymbium and armed on the lateral side with five or six very long, stout, curved dentate hairs. (Page 121) ..... **scopulifera**
   Tibia not so armed 2
2. Dorsal margin of the tibia low, bluntly angulate; head low, no definite lobe. (Page 119) ..... **hortensis**
   Dorsal margin of the tibia produced into a process 3
3. Cephalic pit distant from the posterior lateral eye. (Page 120) ..... **minuta**
   Cephalic pit close to posterior lateral eye 4
4. Head viewed from above with the lateral ridges divergent posteriorly. (Page 123) ..... **simplex**
   Head viewed from above with the lateral ridges parallel or converging behind. (Page 118) ..... **dietrichi**

Tapinocyba dietrichi n. sp.

(Plate II, Figs. 40–44.)

Male.—Length, 1.5 mm. Cephalothorax light orange, viewed from above evenly rounded on the sides with only a slight constriction at the cervical groove, broadly and evenly rounded across the front.

Cephalic lobe with the sides nearly straight and slightly converging posteriorly, abruptly widened and angulated opposite the eyes, bluntly pointed in front. Cephalothorax viewed from the side steeply ascending in a straight line to the cervical groove, then almost level to the base of the cephalic lobe. Cephalic lobe low, evenly rounded over the top, the front projecting slightly. Clypeus slightly convex and protruding. Cephalic pit situated in a shallow oval groove directly behind the posterior lateral eyes.

Posterior eyes in a straight line, equal, the median separated by the diameter and from the lateral by nearly twice the diameter. Anterior eyes in a straight line, the median half the diameter of the lateral, separated from each other by a little less than the diameter and from the lateral by a little more than the diameter.

Sternum orange-yellow, slightly dusky at the margin, broad, convex, abruptly narrowed at, and extended between the hind coxae. Labium and endites orange-yellow, lighter distally; legs dusky orange-yellow, patellae lighter. Abdomen light gray with faint herring-bone pattern of light lines on posterior half.

Femur of palpus moderately long and slender, curved inward; patella short, somewhat widened distally; ratio of length of femur to that of patella as 15 to 7. Tibia obconic, the dorsal margin produced into a rather long, basally broad, apically slender process incurved at tip, laterally broadly concave, nearly straight mesally. Paracymbium very broad at base, nearly flat, and very strongly curved. The tegulum very broad, smooth; bezel very high. Tail-piece of embolic division thin, flat, and rounded, giving rise directly to a thin, flattened embolus which lies over the tip of the bulb and terminates in a slender black point, which is sharply curved back ventrally.

Female.—Length, 1.6 mm. Similar to male in form and color. Head normal. Posterior eyes in a very slightly procurved line, equal, the median separated by a little less than the diameter and from the lateral by a little more. Anterior eyes in a straight line, the median much smaller than the lateral, separated by a little less than the diameter and from the lateral by the diameter. The epigynum consists of a nearly circular plate; the middle lobe flush with the surface, divided into two subcircular parts by a narrow septum.

Holotype, male; *allotype*, female, *paratypes*, 5 ♂, 5 ♀. Berkeley, Cal., October, 1919 (Henry Dietrich).

Tapinocyba hortensis Emerton.

(Plate II, Figs. 45–48.)

Lophocarenum hortense Emerton. Psyche, 31: 143, Fig. 5. 1924.

Male.—Length, 2.5 mm. Cephalothorax bright yellow-orange, smooth and shining. Viewed from above, evenly rounded on the sides to the cervical groove where there is a slight constriction, then gradually narrowed to the broadly rounded front. The cephalic lobe low and short, the sides nearly parallel; viewed from the side rather steeply ascending behind to the cervical groove, then less steeply

ascending in an almost straight line to the top of the lobe. Median ocular area slanting forward at a steep angle. Clypeus nearly straight, slightly protruding. The lobe low, the pit close to the upper hind margin of the posterior lateral eye and at the anterior end of a short, narrow groove.

Posterior eyes in a straight line equal and equidistant, separated by two-thirds the diameter. Anterior eyes in a nearly straight line, the median only slightly smaller than the lateral, separated by one-third the diameter and from the lateral by a little less.

Sternum orange, broad, convex, smooth and shining, narrowly produced between the hind coxae. Labium and endites orange. Legs and palpi orange. Abdomen dull yellowish white.

Femur of palpus long, slender, nearly straight, only slightly widened distally. Patella short and straight. Ratio of length of femur to that of patella as 15 to 5. Tibia short and broad, the dorsal margin produced into a broad, thin lobe cut off obliquely at the mesal angle. Paracymbium slender, curved, hooked at tip. Tegulum not produced ventrally, bezel high and broad. Tail-piece of embolic division stout, curved, its free end thin, flat and rounded and lying at the edge of the cymbium. The embolus arises directly from the tail-piece as a stout, black curved tooth. Dorsad of the embolus and arising as a separate branch, is a thick, curved process, the end of which is turned at a right angle and split to form two points.

Type locality: Holliston, Mass., August 6, 1923 (N. Banks, coll.).

Ohio: Columbus, Marble Cliff, August 15, 1919, 1 ♂ (Barrows).

Tapinocyba minuta Emerton.

(Plate II, Figs. 49–53.)

Lophocarenum minutum Emerton. Conn. Acad. Sci. Trans. 14: 191, Pl. 3, Fig. 8. 1909.

Male.—Length, 1 mm. Cephalothorax grayish orange-yellow; viewed from above evenly rounded on the sides and across the front. The cephalic lobe with the sides strongly convergent posteriorly and constricted at the pits which are far back; at the pits the sides are nearly parallel. Cephalothorax viewed from the side steeply ascending behind, and then gently arched and ascending to the posterior median eyes. Clypeus convex, nearly vertical. Cephalic pits small, round, and situated far back of the posterior lateral eyes in distinct furrows. Posterior eyes in a slightly recurved line, the median separated by about the radius, and from the lateral by two-thirds the diameter. Anterior eyes in a straight line, the median much smaller than the lateral, almost touching but separated from the lateral by a little more than the radius.

Sternum gray over yellow-orange, darker at the edge, posteriorly produced between the hind coxae which are separated by the length. Endites yellow. Legs and palpi dull yellowish. Abdomen pale grayish.

Femur of palpus rather short and thick. Patella relatively long but as stout as femur and curved downward. Ratio of length of femur to that of patella as 9 to 5. Tibia abruptly widened, dorsally produced forward into a bluntly triangular lobe which terminates in a black, slender tooth curved mesally and downward toward the cymbium. The lateral notch next to the paracymbium seems to be lacking. Paracymbium slender and very strongly curved. Tegulum narrow, especially on the mesal side but the bezel is high and rounded. The embolic division consists of a broad, flat, rounded tail-piece which lies on the edge of the tegulum next to the cymbium. From this there arises at nearly a right angle a nearly straight rod which projects from the tip of the bulb and ends in a knob. The knob is twisted, fluted, and ends in a blunt, black point.

In a series of eleven males from Lake Pleasant, New York, the palpus is indistinguishable from the type, but the posterior median eyes are smaller and farther apart.

Female.—Length, 1 mm. Similar to male in form and color. Posterior eyes in a straight line, equal, the median separated by a little less than the diameter and a little closer to the lateral. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by about the radius.

The epigynum has two large, circular, narrowly separated openings.

Type locality: Fitzwilliam, N. H.

New Hampshire: July 20, 1907, 1 ♂, cotype. *New York:* Lake Pleasant, April 27, 1923, 11 ♂, 31 ♀; Auger Pond, November 12, 1916, 4 ♀.

Tapinocyba scopulifera Emerton.

(Plate III, Figs. 54–58.)

Lophocarenum scopuliferum Emerton. Conn. Acad. Sci. Trans. 6: 49, Pl. 14, Fig. 2. 1882.
Minyriolus scopulifer Simon. Ar. Fr. 5: 792. 1884.
Minyriolus scopuliferus Simon. Hist. Nat. Ar. 1: 656. 1894.
Minyriolus scopuliferus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 304.

Male.—Length, 1.3 mm. Cephalothorax dark orange-brown, smooth and shining, narrowly dark at the margin, viewed from above noticeably broad, evenly rounded on the sides, very slightly constricted at the cervical groove, broadly rounded across the front; thorax emarginate posteriorly. Cephalic lobe viewed from above constricted at the pits, with the sides concave and slightly divergent behind, nearly straight across the front; the posterior median eyes borne nearly one-third the distance from the front. Cephalothorax viewed from the side steeply ascending behind to the top of the head, broadly rounded over the top; median ocular area steeply slanting downward; clypeus convex and protruding. Median ocular area clothed with dense stiff hairs parted in the middle.

Posterior eyes in a straight line, the median slightly smaller than the lateral, separated by the diameter and from the lateral by three times the radius. Anterior eyes in a straight line, the median smaller than the lateral, separated by less than the diameter and from the lateral by twice the diameter. The cephalic pit small, situated in a very deep groove under an overhanging ridge, placed above and back of the posterior lateral eye.

Sternum very broad, convex, smooth and shining, dusky orange, darker at the margin. Hind coxae separated by the length. Endites dull orange. Legs orange, patella dusky. Abdomen dark gray, almost black.

Femur of palpus nearly straight in side view, moderately curved inward. Patella short, as thick as femur. Ratio of length of femur to that of patella as 13 to 5. Tibia has the basal part short and obconic but dorsally it is produced into a long, swollen process which is as wide as the basal part and armed on the lateral margin with a row of five long, thick, curved, serrate hairs. The tip of this process is broadly rounded, the mesal margin near the tip is folded under and produced into a heavily chitinized plate which lies across the underside of the tip of the process. Proximally from this plate there is another diagonally transverse chitinized process which is thicker on the mesal end and terminates in a sharp point on the lateral edge near the base of the process; it seems to be attached near the mesal margin under the edge of the distal plate. A large area of the base of the cymbium, under the tibial apophyses, smooth and devoid of hairs. Paracymbium small, slender, strongly curved, slightly hooked at tip. The bezel is smooth and not very high. The median apophysis (or free end of the tegulum) appears as a thin, curved process on the ventral side of the bulb. At the mesal edge of the cymbium the tegulum bears a stout, black tooth. The embolic division has the tail-piece broad, thin, curved and blunt at tip, where it reaches the edge of the cymbium. Basally the tail-piece makes a right-angle turn and gives rise to two processes; the first is the embolus, thick, blunt, and black at tip; the second is basally very broad and thin but it soon narrows to a slender, black style which is very short and curved in a small semicircle around the embolus.

Female.—Length, 1.2 mm. Similar to male; head not so high. Posterior eyes in a straight line, equal, equidistant, separated by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter. The epigynum consists of a convex, dusky yellowish plate, in the center of which are two large, circular, broadly confluent openings. Just back of the openings and confluent with them are two small, circular pits.

Type localities: Cambridge, Waltham and Roxbury, Mass.

New York: Ithaca, December 5 and 29, 1912, many ♂ ♀, under log on Inlet Marsh; McLean, May 10, 1931, 1 ♂; Wappingers Falls, May 27, 1920, 1 ♂; Suffern, Ramapo Mts., May 26, 1924, 7♂ 1 ♀.

Tapinocyba simplex Emerton.

(Plate III, Figs. 59–63.)

Lophocarenum simplex Emerton. Conn. Acad. Sci. Trans. 6: 50, Pl. 14, Fig. 5. 1882.
Diplocephalus simplex Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus simplex Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 306.

Male.—Length, 1.4 mm. Cephalothorax yellowish, lightly suffused with gray, lighter on head; viewed from above rather broad, rounded on the sides and across the front, with a slight constriction at the cervical groove; cephalic lobe broadly rounded in front, the sides straight, converging toward the front; posterior median eyes close to the front margin of lobe. Cephalothorax viewed from the side steeply ascending behind and rounded over the head with no depression at the cervical groove; a depression between the posterior median and anterior median eyes. Clypeus gently convex and slanting forward slightly. Cephalic pit small, round, in a shallow groove back of and above the posterior lateral eye.

Posterior eyes in a slightly procurved line, the median separated by a little more than three times the radius and from the lateral by about twice the diameter. Anterior eyes in a straight line, the median smaller than the lateral, almost touching but separated from the lateral by twice the diameter. Anterior part of the cephalic lobe clothed with forward-directed hairs. Median line of head with a row of four larger hairs.

Chelicerae yellowish. Sternum grayish yellow, darker toward the margin. Endites orange-yellow. Legs yellowish. Abdomen pale gray.

Femur of palpus nearly straight, rather thick. Patella nearly straight, thicker distally. Ratio of length of femur to that of patella as 11 to 5. Tibia with dorsal margin produced into an acute point, the lateral margin of the point shallowly notched near tip and then gently convex to base. Paracymbium broad at base, gradually narrowed toward tip and strongly curved. Tegulum narrow except for the strongly developed bezel which covers the greater part of the ventral surface of the bulb. The embolic division consists of a flat, thin, rounded tail-piece, the tip of which extends over the edge of the tegulum. The apical part is flattened and spirally twisted, the middle part is transparent and the edges black. Unless carefully examined the transparent part is overlooked and the black edges are mistaken for separate branches. The ejaculatory duct follows the edge which is ventral in position at the base of the embolus. The black margin of the opposite edge appears widened and somewhat hooked at tip. The median apophysis appears as a small, sharp tooth between the embolus and the tip of the cymbium.

Female.—Length, 1.2 mm. Similar to the male. Posterior eyes in a procurved line, equidistant, separated by the diameter. Anterior eyes in a straight line, the median much smaller than the lateral, almost touching but separated from the lateral by nearly the diameter.

The epigynum consists of a brownish convex plate with the middle lobe pale. Middle lobe inverted T-shaped, the transverse arms rather

thick, and with the ends obliquely truncate; septum widest in front, strongly constricted before reaching the transverse part. The openings on each side of the septum large, elongate and laterally rounded.

Type locality: Salem, Mass.

Maine: Presque Isle, August 26, 1925, 12 ♂ 10 ♀; Bridgeton, August 22, 1905, 1 ♂, 1 ♀; Long Island, August 27, 1906 (Bryant); Molunkus Pond, August 25, 1925, 1 ♀. *Vermont:* Pittsford, May 8, 1929, 1 ♂, 7 ♀, May 16, 1924, 2 ♀. *New York:* High Falls, Essex Co., August 26, 1921, 4 ♂, 12 ♀; Wilmington Notch, August 26, 1921, 3 ♂, 3 ♀; Auger Pond, November 17, 1916, 1 ♂ (Emerton det.); November 12, 1916, 4 ♀ (Emerton det.); Eglestons Glen, Yates Co., September 24, 1920, 1 ♂, 2 ♀; Connecticut Hill, August 20, 1922, 1 ♂, 4 ♀, November 8, 1919, 1 ♂, October 20, 1920, 1 ♂, 2 ♀, October 19, 1924, 2 ♀; Ringwood, May 20, 1919, 1 ♂; McLean, July, 1904, 1 ♀, May 16, 1925, 1 ♀, April 24, 1924, 1 ♂, 2 ♀; Labrador Pond, June 25, 1922, 1 ♂, 3 ♀; Enfield Glen, Tompkins Co., April 5, 1920, 1 ♂, 7 ♀ (Hayden); Guyanoga (Yates Co.), June 24, 1923, 4 ♀; Mt. McIntyre, July 1, 1923, 1 ♀; Mt. Marcy, August 27, 1930, 1 ♂ (?); Little Pond, Orange Co., May 25, 1920, 2 ♀; Lake Pleasant, April 27, 1924, 13 ♂, 1 ♀; Gilman Lake, Hamilton Co., April 27, 1923, 1 ♀; Delaware Lake, May 20, 1923, 2 ♀; Nigger Pond, Oswego Co., September 3, 1926, 1 ♀; Freeville, May, 1911, 1 ♀; Silver Bay, September 15, 1925, 1 ♀ (Leonard); Alpine, November 2, 1919, 1 ♂, 2 ♀; Mountain Lake, Fulton Co., April 26, 1923, 1 ♂. *New Hampshire:* Fitzwilliam, May 24, 1907, ♀ (Bryant). *Massachusetts:* Gloucester, November 3, 1908, ♂ ♀ (Bryant); Mt. Wachusett, October 29, 1932, 1 ♂.

Lophomma Menge.

Preuss. Spinnen, p. 210. 1867.

Type: *Walckenaera punctata* Blackwall.

The following notes on *L. punctatum* are based on specimens from France determined by Simon.

Cephalothorax viewed from above rounded on the sides, slightly crenulate, a slight constriction at the cervical groove, broadly rounded across the front. The surface coarsely rugose along the radiating lines and towards the margin. Cephalic lobe viewed from above, short, the sides nearly straight, slightly converging behind. Cephalothorax viewed from the side gradually ascending behind, almost flat at the cervical groove, then steeply ascending up the back of the cephalic lobe, nearly flat on top; median ocular area straight, slanting forward. Clypeus very wide, straight, nearly vertical. Cephalic pit small, round, just back of and above the posterior lateral eye, in the anterior end of a long, narrow groove.

Posterior eyes in a very slightly recurved line, the median a little smaller than the lateral, equidistant, separated by the diameter.

Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

Tibia of palpus viewed from above somewhat fusiform in outline, the dorsal margin deeply hollowed out and armed dorsally with a long, stout, pointed, erect, process and on the lateral side with a long, truncate process the sides of which are parallel. On the mesal side, the true distal margin is thin, semitransparent, smoothly rounded. The embolic division consists of a broad, thin, flat, rounded tail-piece which gives rise directly to two branches, the distal one gently curved laterally, with the sides parallel, the other one broader and ending in a small, black point. The median apophysis a small, brown point hidden under the edge of the tegulum.

We place in Lophomma five species that seem to be closely related in having the embolic division of a peculiar type. The tail-piece is broad and gives rise to two branches of which the distal one is the embolus proper. The cephalothorax is more or less coriaceous.

KEY TO THE SPECIES OF LOPHOMMA, MALES.

1. Dorsal margin of tibia concave or gently convex..... 2
   Dorsal margin of tibia armed with a distinct process..... 3
2. Cephalothorax coarsely punctate. (Page 128).....**umbilicatum**
   Cephalothorax not coarsely punctate. (Page 127).....**sylvaticum**
3. Cephalic lobe high, viewed from the side distinctly concave between the posterior median and anterior median eyes. (Page 126).....**pingrensis**
   Cephalic lobe lower, not concave in the median ocular area..... 4
4. Cephalic lobe viewed from above with its limiting ridges nearer together than the posterior lateral eyes. Cephalothorax rugose. (Page 128), **vaccinii**
   Cephalic lobe as wide as posterior eye row, not narrowed posteriorly. Cephalothorax smooth. (Page 125).....**depressum**

Lophomma depressum Emerton.

(Plate III, Figs. 64–68.)

Lophocarenum depressum Emerton. Conn. Acad. Sci. Trans. 6: 50, Pl. 14, Fig. 6. 1882.
Diplocephalus depressus Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus depressus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 305.

Male.—Length, 2.5 mm. Cephalothorax broad and evenly rounded on the sides to the cervical groove where there is a slight depression, broadly rounded across the front. Sides of cephalic lobe gently convex. Cephalothorax viewed from the side ascending to the posterior median eyes with only a slight depression at the cervical groove and gently arched over the back of the head. Clypeus convex and slanting forward. Clypeus with hairs directed upward. Cephalic pit some distance back of the posterior lateral eye in a very shallow groove.

Posterior eyes in a procurved line, the median separated by a little less than the diameter and from the lateral by a little more than the diameter. Anterior eyes in a slightly recurved line, the median smaller than the lateral, separated by the radius and from the lateral by twice the diameter.

Chelicerae rather stout with numerous minute setigerous tubercles. Sternum broad, rounded, convex. Posterior coxae separated by less than the diameter.

Femur of palpus rather stout, curved inward and distinctly thickened distally. Patella curved a little downward. Ratio of length of femur to that of patella as 34 to 14. Tibia shorter ventrally than patella, dorsally produced into a long, rather stout, sharp-pointed apophysis, the tip curving outward and upward. Paracymbium strongly curved. Tegulum convex, bezel rounded. The embolic division consists of a broad, rounded basal part from which arises two erect processes, one is slender and curved and contains the ejaculatory duct, the other is black, stouter, longer and sharp-pointed; it lies next to the bezel. In the form of the embolic division this species resembles *Ceratinops crenatus*. The median apophysis is broadly rounded at tip with a sharp, black tooth at one corner.

Type locality: Mt. Washington, N. H.

District of Columbia: Washington, October, 1 ♂ (Fox).

Lophomma pingrensis n. sp.

(Plate III, Figs. 69–73.)

Male.—Length, 1.1 mm. Cephalothorax chestnut brown with darker radiating lines; viewed from above broad, evenly rounded on the sides with scarcely any constriction at the cervical groove, bluntly rounded across the front. Cephalic lobe broadly rounded in front and behind, widest behind the middle with the sides nearly straight, diverging posteriorly. Cephalothorax viewed from the side, steeply ascending behind, then almost level to the base of the cephalic lobe. Cephalic lobe rather high, broadly rounded over the back, almost level on top, the front convex and somewhat overhanging. Clypeus nearly straight, protruding, the margin convex. Sternum broad, dull yellowish, strongly suffused with dusky. Endites lighter. Legs dusky yellowish. Abdomen dark gray.

Posterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by three times the radius and from the lateral by three times the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by half the radius and from the lateral by a little less than the diameter. Cephalic pit placed some distance above the posterior lateral eye and slightly back of it.

Femur of palpus short, thick and slightly curved inward. Patella short, thick, curved downward. Ratio of length of femur to that of patella as 14 to 6. Tibia short and broad, armed mesodorsally with a long, curved, tapering apophysis the tip of which is more slender, bent laterally, and minutely dentate. Laterally from the base of the apophysis, the margin of the tibia broadly and evenly excavated and armed with a small, triangular, black tooth which arises below the margin. Laterally this excavation is bounded by a short, rounded, incurved tooth. Paracymbium stout and strongly curved. Tegulum compressed and protuberant ventrally. The tail-piece is of two parts; flush with the edge of the tegulum there is an ovate, smooth portion

from the inner side of which a broad piece connects it with the base of the embolus. The embolus is a black style which emerges from a deep notch in the edge of the tegulum and then is spirally curved. The tip flat and widened by semitransparent membrane, the duct opening in one corner of the truncate tip. At the base of the embolus there arises a pair of black processes, the longer of which is beak-shaped and the other is smaller, more slender, with the tip somewhat twisted.

Female.—Length, 1.3 mm. Similar to the male in color. Posterior eyes in a slightly procurved line, equal, the median separated by a little more than the diameter and from the lateral by three times the radius. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

The epigynum is a convex plate. The median fovea very narrow, broader and rounded in front; the posterior margin occupied by two almost contiguous plates the posterior margin of which is gently rounded.

Holotype male, allotype female, Pingree Park, Colo., Aug. 20, 1927. *Paratypes*, 8 ♂, 27 ♀, same locality. Collected by sifting moss growing at margin of small pond.

Lophomma sylvaticum Emerton.

(Plate III, Figs. 74–77.)

Lophocarenum sylvaticum Emerton. Conn. Acad. Sci. Trans. 18: 215, Pl. I, Fig. 9. 1913.

Male.—Length, 1.5 mm. Cephalothorax orange-yellow, strongly suffused with gray, viewed from above, evenly rounded on the sides with a slight constriction at the cervical groove, the clypeus produced in front and bluntly pointed. The cephalic lobe with the sides nearly parallel and broadly rounded behind. Cephalothorax viewed from the side rather steeply ascending behind and then almost flat to the base of the cephalic lobe which is rather high and rounded over the back to the posterior eyes; median ocular area slightly concave. Clypeus convex and strongly protruding. The cephalic pit in a broad, shallow groove which is rounded in front and tapers to a point behind.

Posterior eyes in a slightly procurved line, the median slightly larger than the lateral, equidistant, separated by three times the radius. Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

Sternum yellowish, strongly suffused with dusky, darker at the margin, broad, convex, smooth and shining. Labium dark; endites lighter. Legs yellowish orange. Abdomen dark gray.

Femur of palpus rather slender, only slightly thicker distally. Ratio of length of femur to that of patella as 14 to 6. Tibia viewed from above produced into a short, bluntly-rounded lobe, the lateral margin smooth and almost straight. Paracymbium small and strongly hooked at tip. The bezel is greatly developed, strongly convex, the edge smooth and nearly straight. The embolic division consists of a thin tail-piece, broad basally and with the tip turned at nearly a right angle and overlying the edge of the tegulum. The embolus consists of a

spirally curved style the tip of which rests against the tip of a black, sharp-pointed process which arises near the base of the embolus. The embolus itself is continuous with the lateral edge of the tail-piece.

Type locality: Mt. Whiteface, N. H., Aug. 9, 1911.

Redescribed from a cotype.

Lophomma umbilicatum n. sp.

(Plate IV, Figs. 78–81.)

Male.—Length, 1.6 mm. Cephalothorax dull orange with dark radiating lines, sculptured with deep, round pits, arranged in rows along the radiating lines and scattered along the margin on the clypeus and chelicerae. Cephalothorax viewed from above broadly rounded on the sides with scarcely any constriction at the cervical groove. The eyes in profile. Cephalic lobe with the sides abruptly widened and angled behind the lateral eyes, then nearly straight and slightly converging behind. Cephalothorax viewed from the side gradually and gently rounded over the back to the base of the cephalic lobe, which is only moderately high and rounded over the top to the posterior eyes. Clypeus almost straight and very slightly protruding. Cephalic pits situated in deep narrow grooves.

Posterior eyes in a slightly recurved line, the median a little smaller than the lateral, separated by a little more than the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by a little less than the radius and from the lateral by the radius.

Sternum deep russet, broad, convex and strongly pitted. Labium same color as sternum; endites lighter. Legs dusky orange, patellae gray. Abdomen dark gray, almost black.

Femur of palpus rather long, slender at base, thicker distally, curved inward and upward. Ratio of length of femur to that of patella as 19 to 7. Tibia produced dorsally into a stout, sharp-pointed process, curved laterally at tip; laterally from this process there is a broad, evenly rounded emargination which is bounded laterally by a stout, blackish tooth curved downward. Paracymbium strongly curved with a shallow notch near tip. Bezel broad, strongly convex, the edge nearly straight and blackish. The embolic division consists of a broad, thin, flat tail-piece from which there arises two processes, the ventral one jet black and bird-head shaped, the other process, the embolus proper, is a black style which curves around above the former and its tip seems to be protected by it.

Holotype male, Mud Pond, Zurich, N. Y., May 17, 1931. 1 ♂.

Lophomma vaccinii Emerton.

(Plate IV, Figs. 82–87.)

Lophocarenum vaccinii Emerton. Can. Ent. 58: 116–117, Fig. 5. 1926.

Male.—Length, 1.8 mm. Cephalothorax dark chestnut brown, the darker radiating lines marked with shallow pits. Viewed from

above, evenly rounded on the sides with scarcely any constriction at the cervical groove, broadly rounded across the front. The cephalic lobe with the sides nearly parallel and with a median row of long, light-colored hairs directed forward. Cephalothorax viewed from the side, evenly and broadly rounded over the back to the base of the cephalic lobe which is steeply ascending behind then gently rounded out to the posterior median eyes. Clypeus nearly straight and slightly protruding. Cephalic pit small, round, placed immediately behind, and almost on a level with the posterior lateral eyes.

Posterior eyes in a nearly straight line, equal and equidistant, separated by the diameter. Anterior eyes in a nearly straight line, median smaller than the lateral, separated by about the radius and from the lateral by the diameter.

Sternum brown suffused with dusky, darker at the margin, sides somewhat produced between the coxae, broadly produced between the hind coxae. Labium brown. Endites dusky orange. Legs and palpi orange, strongly suffused with dusky. Abdomen dark gray.

Femur of the palpus long, slender, widened distally and curved inward. Patella moderately long and slender. Ratio of length of femur to that of patella as 17 to 7. Tibia long, slender, somewhat widened; armed dorsomesally with a long, slender, curved apophysis hooked at tip; the dorsolateral angle produced into a sharp, thin ridge. Paracymbium broad at base, sharply tapering, hooked at tip. Tegulum high, slightly protuberant ventrally, the bezel not greatly developed. Tail-piece of the embolic division stout and curved, its free end lying near the edge of the cymbium. The embolus proper arises directly from the tail-piece as a slender, curved, style-like process just below which there is a large, stout, black, curved tooth.

Female.—Length, 2 mm. Posterior eyes in a slightly procurved line, the median separated by one and one-third times the diameter and from the lateral by a little less than the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by the diameter. The epigynum strongly convex with the middle lobe narrower basally than at tip.

Described from a single ♂ and 3 ♀ types in the collection of the Museum of Comparative Zoology, Cambridge, Mass.

Type locality: Holliston, Mass., March 25, 1924. (Emerton).

Hypomma Dahl.

Monograph Erigonen Arten, p. 88. 1886.

Type: *Theridion bituberculatum* Wider.

Our single American representative of this genus is very closely related to the type species from which it differs in the form of the thickened spine on the tibia. The structure of the bulb is practically the same.

Hypomma marxii Keyserling.

(Plate IV, Figs. 88–92.)

Erigone ma[r]xii Keyserling. Spinnen. Am. Therid. 2: 152, Pl. 16, Fig. 218. 1886.
Dicyphus bilobatus Banks. Can. Ent. 28: 63. 1896.
Hypomma bilobata Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 310.
Lophocarenum bilobatum Emerton. Conn. Acad. Sci. Trans. 16: 390, Pl. 2, Fig. 1. 1911.

Male.—Length, 1.8 mm. Cephalothorax orange, darker at the margin, cephalic lobes yellow. Cephalothorax viewed from above short and broad, evenly rounded on the sides with a slight constriction at the cervical groove; evenly and broadly rounded across the front. Cephalic lobe divided into two elongate oval parts by a deep longitudinal groove. Below the lobe on each side there is a broad, rounded protuberance. Cephalothorax viewed from the side evenly and gently ascending behind to the cervical groove, then steeply ascending in a nearly straight line to the top of the lobe, evenly and broadly rounded over the top of the lobe to the posterior median eyes. Cephalic pit distinct, a little behind and above the posterior lateral eyes, a little below the level of, and some distance back of the posterior median eye, in the front end of a distinct groove which is bounded below by a swollen ridge which posteriorly becomes a sharp ridge. Clypeus slightly convex and slightly protruding, clothed in the middle with a patch of short, erect hairs.

Sternum yellow-orange, narrowly margined with dusky, very broad, nearly triangular. Labium dusky, endites orange, lighter distally. Legs and palpi orange. Abdomen dark gray.

Posterior eyes in a very slightly recurved line, the median separated by a little less than the diameter and from the lateral by a little more than the diameter. Anterior eyes in a straight line, the median slightly smaller than the lateral, separated by a little more than the radius and from the lateral by three times the radius. Eyes borne in front of and below the two prominent lobes.

Femur of palpus rather stout, strongly curved inward, armed above with a median row of 7 or 8 short, brown hairs, and scattered hairs on the distal half. Papella stout. Ratio of length of femur to that of patella as 21 to 13. Tibia short and broad. The mesodorsal angle produced into a long, slender, curved process which lies close to the cymbium. At the dorsal margin there is a long, stout, flattened, spine which is curved forward. The lateral angle of the tibia is widened, the margin thin and semitransparent where it extends over the base of the small, strongly curved paracymbium. Bezel rather low, with the edge smooth and straight. Tail-piece of the embolic division thin and flat, constricted in the middle. The embolus a long, slender style spirally curved but not coiled, the tip protected by a voluminous membranous conductor.

Female.—Length, 2.2 mm. Similar to male but head normal. Posterior eyes in a very slightly recurved line, equal, the median separated by a little less than the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median slightly smaller than the lateral, separated by half the radius and from the lateral by a

little less than the diameter. Epigynum grey, convex, transverse; the median fovea rounded in front, the median lobe small, narrow, biconcave.

Type locality: Eagle Harbor, Lake Superior.

New York: McLean, May 14, 1919, 2 ♂; May 16, 1925, 1 ♂; May 30, 1919, 1 ♀. Found in loose moss hanging on the sides of tussocks standing in water near Mud Pond in the Lloyd-Cornell Wild Life Preserve in company with "*Hypomma*" *trilobata*. Many egg-clusters of the four-toed salamander (*Hemidactylium scutatum*), were found in the same situation. Emerton also records this species from South Framingham, Mass. Banks recorded this species from Olympia, Washington.

This species is very closely related to H. *bituberculata* Wider. The genital bulb is practically the same in both species. The most striking differences are in the form of the thickened spine on the tibia which in that species is greatly widened at the tip and in the tibial apophysis which is more strongly curved and finely denticulate at tip.

Aulacocyba Simon.

Ar. Fr. 6: 518. 1926.

Type: *Erigone subitanea* Cambridge.

This genus is represented in America by the type species, a single specimen of which was found in Boston, Mass.

Aulacocyba subitanea Cambridge.

(Plate IV, Figs. 93–98.)

Erigone subitanea Cambridge. Ann. Mag. Nat. Hist. ser. 4, 16: 249, Pl. 8, Fig. 7 (3). 1875.
Walckenaera subitanea Cambridge. Spiders of Dorset, p. 144. 1879–81.
Tapinocyba subitanea Simon. Ar. Fr. 5: 783, Figs. 697–699. 1884.
Tapinocyba parisiensis Simon. Ar. Fr. 5: 784, Figs. 700–701. 1884.
Microtenonyx subitanea Dahl. Schr. Ver. Schlesw. Holst. 5: 81. 1886.
Tapinocyba subitanea and *parisiensis* Jackson. Nat. Hist. Soc. Northum. Durham, etc. Trans. n. s. 1: 254, Pl. 7. 1905.
Tapinocyba subitanea de Lessert. Cat. Ar. Suisse, p. 158. 1910.
Aulacocyba subitanea and *parisiensis* Simon. Ar. Fr. 6: 441, Fig. 780. 1926.
Lophocarenum domiliciliorum Emerton. Conn. Acad. Sci. Trans. 16: 392, Pl. 2, Fig. 5. 1911.

Male.—Length, 1.2 mm. Cephalothorax light brownish yellow, an area in front of the dorsal furrow and radiating lines lighter; viewed from above evenly rounded on the sides to the cervical groove where there is a slight constriction; the sides in front of the cervical groove slightly convex and gently converging to the bluntly rounded front. Anterior eyes in profile. Cephalic lobe low, rather short and wide, its sides nearly straight and parallel, notched above the pits. Cephalothorax viewed from the side steeply ascending behind to the cervical

groove, then more gently ascending to the back of the cephalic lobe, broadly rounded over the top of the lobe to posterior median eyes. Cephalic pit small, in a broad groove, a short distance back of and just above the level of the posterior lateral eye. Clypeus straight and slightly protruding.

Posterior eyes in a slightly procurved line, equal and equidistant, separated by about two-thirds the diameter. Anterior eyes in a straight line, median slightly smaller than the lateral, subcontiguous, separated from the lateral by the diameter.

Sternum brownish yellow, suffused with dusky, broad, convex, smooth and shining. Labium and endites dusky orange, lighter distally. Legs and palpi orange-yellow, patellae lighter. Abdomen light gray.

Femur of palpus rather long, slender, only slightly widened distally, gently curved inward. Patella short, stout. Ratio of length of femur to that of patella as 15 to 5. Tibia narrow at base, greatly widened distally and bearing on its dorsomesal angle a long, thin, curved apophysis, laterad of which there is a broad emargination. The dorso-lateral angle produced into a thin edge. Paracymbium broad and flat at base, narrowed at tip. Tegulum protuberant ventrally; the bezel high, transversely fluted. Tail-piece of the embolic division broad, flat, curved, its tip lying next to the edge of the cymbium. Embolus basally stout, apically more slender and strongly hooked, lying at almost a right angle across the stout median apophysis.

Female.—Length, 1.3 mm. Head normal. Posterior eyes in a straight line, equal, the median separated by two-thirds the diameter and a little closer to the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by two-thirds the diameter and a little closer to the lateral. Epigynum has the middle lobe much narrower behind than in front with a small dark opening on each side.

Type locality: Bloxworth Rectory, Dorset, England.

Massachusetts: Boston, November, 1910, 1♂ (type of *Lophocarenum domiciliorum* Em.). Taken in the basement of a building where it may have been imported in packing. This specimen seems to agree more closely with the variety *parisiensis* than with the typical form. *England:* London, 1♂, 5♀. *France:* 2♂, 2♀ (Simon collection).

We are indebted to Louis Fage for these specimens for comparison.

Hypselistes Simon.

Hist. Nat. Ar. 1: 671. 1894.

Type: *Erigone florens* Cambridge.

This genus contains a single species which cannot be placed conveniently with any other. The form of the tibia of the male palpus and the structure of the palpal organ serve to distinguish it from the other members of the group.

Hypselistes florens Cambridge.

(Plate IV, Figs. 99–103.)

Erigone florens Cambridge. Zool. Soc. Lond. Proc. 1875, p. 408, Pl. 46, Fig. 10.
Lophocarenum florens Emerton. Conn. Acad. Sci. Trans. 6: 46, Pl. 12, Fig. 3. 1882.
Erigone florens Keyserling. Spinnen Am. Therid. 2: 158, Pl. 16, Fig. 223. 1886.
Lophocarenum florens Banks. Phila. Acad. Nat. Sci. Proc. 1892, p. 35.
Hypselistes florens Simon. Hist. Nat. Ar. 1: 671. 1894.
Hypselistes florens Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 316.
Lophocarenum florens Emerton. Conn. Acad. Sci. Trans. 16: 393, Pl. 2, Fig. 7a, c. 1911.

Male.—Length, 2.5 mm. Cephalothorax orange; the cephalic lobe pale yellow. Cephalothorax viewed from above broad, evenly rounded on the sides with a very slight constriction at the cervical groove, evenly and broadly rounded across the front; cephalic lobe broader than long; the sides nearly straight and parallel, hind angles rounded; front angles more nearly square, broadly rounded across the front. Cephalothorax viewed from the side rather steeply ascending behind to the cervical groove and then gently ascending to the base of the cephalic lobe. The cephalic lobe very high, steeply ascending behind and rounded over the top to the posterior median eyes. Front of lobe convex and slightly retreating. Clypeus slightly concave, then convex and slightly protruding. Cephalic pit in a broad groove just behind and slightly above the posterior lateral eyes.

Posterior eyes in a procurved line, equal, the median separated by a little more than twice the diameter, and from the lateral by about five times the diameter. Anterior eyes in a very slightly procurved line, equal, the median separated by a little less than the diameter and from the lateral by twice the diameter.

Sternum orange with a narrow dusky margin, broad, convex. Labium and endites orange, the latter lighter distally. Legs with coxae, trochanters and femora bright orange, the remaining segments strongly suffused with dusky. Palpi orange-yellow. Abdomen dark gray, nearly black.

Femur of palpus moderately long and stout, widened distally and curved inward. Patella long, straight and cylindrical. Ratio of length of femur to that of patella as 19 to 11. Tibia relatively short, compressed dorsally and produced into a rather stout, black, triangular process which is incurved at tip, mesally bounded by a smooth, deep, semicircular notch which separates it from a shorter triangular tooth. This process is deeply hollowed out. The cymbium basally with a heavy, diagonal ridge which is armed with a row of short, stiff, procurved hairs. Paracymbium sickle-shaped. Tegulum very narrow; the bezel produced along the base of the embolus to form a sheath. Tail-piece of the embolic division rather slender, straight, constricted and ends in a foot-shaped lobe at the edge of the tegulum. The embolus is a long, black style which appears to be double basally and curves around the bulb in an oval loop, the tip resting in a groove in the tip of the median apophysis. The latter is extraordinarily developed and deeply grooved distally.

Female.—Length, 2.2 mm. Similar to male in form and color. Head normal. Posterior eyes in a straight line, equal, the median separated by the diameter and from the lateral by twice the diameter. Anterior eyes in a very nearly straight line, the median slightly smaller than the lateral, separated by a little more than the radius and from the lateral by a little more than the diameter. The epigynum a quadrate plate, the median fovea narrower behind than in front and bounded in front by a transverse ridge the posterior margin of which is biconcave posteriorly, thus leaving a median tooth projecting backward in the middle. The middle lobe with a transverse ridge near the posterior margin.

Nova Scotia: Truro, 1 ♂ young (Emerton, det.); Digby, 1 ♂, 1 ♀ (Emerton, det.). *New Hampshire:* Pike, May, 1908, 3 ♀ (Hayhurst). *Maine:* Long Island, September 14, 1909, ♂ young (Bryant). *Massachusetts:* Lexington, May 31, 1913, ♂ (Bryant); Petersham, May 27, 1913, ♂ (Bryant); Readville, November, 1918, ♂ young (Emerton); Saugus, June 12, 1873, ♂ ♀ (Emerton). *New York:* Ithaca, 2 ♀ recorded by Banks (1892); June, 4 ♀; Milton, April 25, 1929, 2 ♂; Highland, April 25, 1925, 1 ♂, 1 ♀; Taughannock Falls, May 24, 1919, 2 ♂ (Dietrich); McLean, May 30, 1921, 2 ♀; May 18, 1919, 1 ♂, 1 ♀; May 5, 1920, 1 ♂; June 21, 1924, 1 ♀; May 6, 1920, 1 ♂; April 30, 1930, 1 ♂; May 22, 1904, 1 ♂, 1 ♀; July, 1904, 6 ♀; Rock City, Catt. Co., June 5, 1915, 3 ♀; Black Brook, Clinton Co., June 11, 1916, 3 ♀; Bluff Point, September, 1911, 1 ♀ young; Johnstown, August 12, 1911, 1 ♀; Deruyter Lake, July 4, 1922, 1 ♀; Pawling, April 19, 1931, 1 ♂; Freeville, July, 1904, 2 ♀. *Pennsylvania:* Hazleton, May 27, 1925, 3 ♀ (Dietz). *Maryland:* May, 5 ♀ (Fox). *Virginia:* Falls Church, 1 ♂, 1 ♀ (Banks). *District of Columbia:* May, 1 ♀ (Fox). *Michigan:* ♂, ♀ (Banks collection). *Ohio:* Wooster, August-September, 1917, 3 ♀ (Lowry).

Minyriolus Simon.

Ar. Fr. 5: 656. 1884.

Type: *Theridion pusillus* Wider.

The following notes on *M. pusillus* are made from specimens from France determined by L. Fage.

Male.—Cephalothorax viewed from above evenly rounded on the sides with scarcely any constriction at the cervical groove, narrowed towards the front. Cephalic lobe short, sides nearly straight, slightly converging posteriorly. Cephalothorax viewed from the side abruptly ascending behind for a short distance, then ascending steeply in a straight line to the cervical groove, flat to the base of the cephalic lobe. Cephalic lobe broadly and evenly rounded over the back to the posterior median eyes. Median ocular area straight, slanting forward. Clypeus slightly convex and nearly vertical. Cephalic pit small, round and deep in the center of a broad, rounded depression.

Posterior eyes in a procurved line, the median slightly larger than the lateral, separated by the diameter and from the lateral by twice the diameter. Median ocular area with a group of divergent hairs. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by about the radius and from the lateral by a little more.

Tibia of palpus short, deeply hollowed out distally, the center of the dorsal margin broadly and evenly excavated, mesally from this excavation, armed with a long, sharp-pointed process which is strongly curved laterally and armed with a large, sharp tooth on the lateral side. Laterally from the excavation, the margin forms a short, triangular, rounded tooth.

Tail-piece of embolic division rather short and lies toward the tip of the palpus. It gives rise directly to a long, black, styliform embolus which basally is thin and broad; it makes one turn around the ventro-lateral side of the bulb.

In Minyriolus we place three species.

KEY TO THE SPECIES OF MINYRIOLUS, MALES.

1. Anterior eyes in a strongly procurved line, the median, viewed from the side, above the level of the pit. (Page 136).....**arenarius**
   Anterior eyes in a straight or slightly procurved line, the anterior median on or below the level of the pit..... 2
2. Cephalic lobe wider in front than behind. (Page 135).....**aquatilis**
   Cephalic lobe with sides parallel, constricted above pits. (Page 138), **castaneus**

Minyriolus aquatilis n. sp.

(Plate V, Figs. 104-109.)

Male.—Length, 1.4 mm. Cephalothorax yellowish brown strongly suffused with dusky; viewed from above rather short and broad, evenly rounded on the sides with only a slight constriction at the cervical groove, bluntly pointed in front. The cephalic lobe short, the sides gently converging posteriorly, rounded behind, truncate in front. Cephalothorax viewed from the side gently ascending behind to the cervical groove and then abruptly rounded over the cephalic lobe to the posterior median eyes. Median ocular area convex above and notched across the middle by a transverse groove. Clypeus slightly concave and strongly protruding. Sternum grayish brown, darker at the margin. Endites paler. Legs bright orange-yellow. Abdomen dark gray, almost black. Posterior eyes in a procurved line, equal, the median separated by twice the diameter and from the lateral by nearly four times the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by the diameter and from the lateral by twice the diameter. Cephalic pit large, placed behind and a little above the posterior lateral eye, in a broad, deep groove.

Femur of the palpus gently curved inward, patella straight and slightly widened distally. Ratio of length of femur to that of patella as 13 to 8. Tibia short, abruptly widened distally and produced laterally.

From the mesal angle there projects a long process gently curved, suddenly narrowed toward the tip, and armed on the lateral margin with two stiff hairs. Laterally from the base of this process is a broad, rounded notch and laterally from this a rather long, stout tooth which in side view seems to be incurved.

Paracymbium stout, strongly curved, notched at tip. The tegulum is enlarged and rounded ventrally, with the edge straight and the bezel semitransparent. The tail-piece of the embolic division is a rather large, semitriangular plate which overlies the edge of the tegulum. The tail-piece is connected to the base of the embolus by a narrow irregular middle piece from which the very long, slender, style-like embolus arises. The embolus consists of two supporting rods at the base but soon becomes single and is coiled around the lateral side of the bulb, making a little more than one turn. The median apophysis appears as a basally stout, apically slender and pointed piece lying within the coil of the embolus.

Female.—Length, 2 mm. Similar to the male in color. Posterior eyes in a very slightly procurved line, the median larger than the lateral, separated by the diameter and from the lateral by a little less. Anterior eyes in a slightly procurved line. The median smaller than the lateral, separated by the diameter and from the lateral by a little more. The epigynum strongly convex with the central fovea rather small and containing an inversely T-shaped septum, the posterior arms of which are thick and nearly square.

Holotype, male, *allotype*, female, Point Breeze, Orleans County, N. Y., June 11, 1922. *Paratypes*, 17 females from the same locality.

Minyriolus arenarius Emerton.

(Plate V, Figs. 110–115.)

Lophocarenum arenarium Emerton. Conn. Acad. Sci. Trans. 16: 391, Pl. 2, Fig. 4. 1911.

Male.—Length, 1.8 mm. Cephalothorax dark brown with blackish radiating lines and a blackish quadrate spot at the cervical groove. Cephalic lobe outlined with a blackish line on the sides and behind. Cephalothorax viewed from above broad, widest opposite the second coxae, rounded on the sides behind, the sides strongly convergent towards the front, broadly rounded across the front; viewed from the side rather steeply ascending posteriorly to the cervical groove and then more gradually to the base of the cephalic lobe. Cephalic lobe rather long but not very high, evenly rounded over the top to the anterior median eyes. Clypeus nearly straight, slanting forward and clothed with numerous stiff hairs directed upward. Cephalic pits small and situated in shallow grooves.

Posterior eyes in a nearly straight line, equal and equidistant, separated by three times the radius. Anterior eyes in a strongly

procurved line, the median smaller than the lateral, almost touching but separated from the lateral by one and one-half times the diameter.

Sternum broad, rounded, dark colored, smooth and shining. Hind coxae separated by the diameter. Endites dull yellowish strongly suffused with gray. Chelicerae grayish yellow, rather weak, retreating. Legs and palpi honey yellow, more or less grayish. Coxae marked below with a blackish longitudinal line; margin black. Femora, tibia and metatarsi of first and second legs armed below with numerous stiff, erect hairs. First and second femora enlarged. In a specimen from Pine Island, N. Y., the legs are a clearer yellow and the coxae are unmarked below except for a narrow black margin. Abdomen black, projecting strongly over the cephalothorax.

Femur of palpus rather short and stout, nearly straight, when viewed from above distinctly widened distally. Patella short and thick, viewed from above much wider at tip than at base and wider than femur. Ratio of length of femur to that of patella as 18 to 11. Ventrally the tibia is shorter than patella, dorsally much longer. Viewed from above the dorsolateral apophysis is wide at base, rather stout and is gently curved outward, the tip black, widened and ending in a sharp point directed mesally, the lateral angle being nearly square. Viewed from the right angle on the mesal side the process seems to end in two points (Fig. 113). Tarsus short and thick. Paracymbium very strongly curved like a figure 6, the tip slightly enlarged, the free base appears as a triangular point at the lateral edge of the tibial process when viewed from above. Tegulum enlarged ventrally, the edge extended into a high pointed bezel. The embolic division has a short, curved tail-piece which extends to the edge of the tegulum; from this there arises directly a long, curved embolus which makes one and one-half turns around the end of the bulb and is protected during the distal half by a membranous conductor.

Female.—Length, 2 mm. Similar to the male but the hairs under the first and second legs are longer and not so numerous. Posterior eyes in a very gently procurved line, equal, the median separated by the diameter and a little nearer to the lateral. Anterior eyes in a procurved line, the median smaller than the lateral, very close together and a little farther from the lateral. The epigynum consists of a quadrate middle lobe, bounded by lateral furrows converging posteriorly. In front of and overlying the middle lobe is a light colored lobe semicircularly rounded behind.

Type localities: Ipswich and Lynn, Massachusetts.

New York: Summit of Mt. MacIntyre, July 1, 1923, 2♂, 4 ♀; Pine Island, Orange Co., May 19, 1920, 1 ♂; Clyde, April 20, 1921, 1 ♂. *Massachusetts:* Ipswich, May 11, 1912, 1 ♂, 1 ♀ (Emerton) types.

Minyriolus castaneus Emerton.

(Plate V, Figs. 116–121.)

Lophocarenum castaneum Emerton. Conn. Acad. Sci. Trans. 6: 45, Pl. 12, Fig. 1. 1882.
Lophocarenum montanum Emerton. Conn. Acad. Sci. Trans. 6: 45, Pl. 12, Fig. 2. 1882.
Diplocephalus castaneus Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus montanus Simon. Hist. Nat. Ar. 1: 615. 1894.
Diplocephalus castaneus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 304.
Diplocephalus montanus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 305.

Male.—Length, 2.1 mm. Cephalothorax brown over orange with darker radiating lines; viewed from above rather long with sides evenly rounded to the cervical groove where there is a very slight constriction, smoothly rounded across the front. Cephalic lobe evenly rounded in front with the posterior median eyes borne close to the front margin, the sides gently convergent posteriorly. Cephalothorax viewed from the side evenly arched over the thorax to the cervical groove; head rather high, steeply ascending and rounded over the back, gently rounded above; a deep notch between the posterior and anterior median eyes. Cephalic pits round, situated in the anterior end of a large, oval furrow, pointed behind. Clypeus concave due to the protuberance of the anterior median eyes.

Posterior eyes in a procurved line, the median separated by about twice the diameter and from the lateral by a little less. Anterior eyes in a straight line, the median slightly smaller than the lateral, almost touching but separated from the lateral by three times the radius. A group of erect hairs just above the anterior median eyes.

Chelicerae yellow-orange, smooth, nearly straight; upper margin of the furrow armed with three long, stout, evenly spaced teeth. Sternum light dusky orange, rather long. Posterior coxae separated by less than the diameter. Endites lighter than sternum. Legs and palpi orange. Abdomen rather long, narrower in front, gray.

Femur of palpus nearly straight, gently curved inward, gradually enlarged distally. Patella straight, much thickened distally. Ratio of length of femur to that of patella as 25 to 15. Tibia short, armed dorsally with a long, slender, outwardly curved apophysis on the lateral side of which there is a deep, rounded notch. When viewed from the outer side the dorsal process is seen to be deeply excavated by a groove which divides it into an inner and an outer layer. Lateral process of the tibia short, bluntly rounded. Paracymbium strongly curved, hooked at tip. Tegulum somewhat protuberant ventrally; bezel high. The embolic division consists of a thin, gently curved tail-piece which extends to the edge of the tegulum. Basally it makes a right turn towards the interior of the bulb where it gives rise to the embolus which consists of two black, parallel rods curved around in more than a complete turn on the mesodistal side of the bulb. The inner rod is about half as thick as the outer. The ejaculatory duct at first attaches itself to the inner rod near its base and then passes over to the outer rod. The opening is near the tip on the outer side.

Female.—Length, 2.5 to 4 mm. Similar to male in form and color, head normal. Posterior eyes in a slightly procurved line, equidistant, separated by the diameter. Anterior eyes in a slightly recurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by the radius. The epigynum consists of a convex, orange plate with the middle lobe pale. Middle lobe broad with the lateral furrows strongly convergent forward, posteriorly broadly rounded and marked on the face with an impressed double arcuate line rounded behind.

Type localities: Beverly, Swampscott and Milton, Mass.

New Hampshire: Base Station, Mt. Washington, August 18, 1925, 1 ♂; Mt. Washington, June, 1877, 1 ♂ (Type of *L. montanum* Emerton). *Massachusetts:* Hammond Pond, October 17, 1904 (Bryant). *New York:* Cold Spring Harbor, April 10, 1905, 1 ♂, 1 ♀ (Emerton det.); Mt. Whiteface, August 22, 1916, 2 ♂, 2 ♀; Lake Tear, Mt. Marcy, September 4, 1922, 2 ♂, 1 ♀; Bryant Lake, October 3, 1931, 1 ♂.

Banks (Phila. Acad. Nat. Sci. Proc. 1892, p. 35) recorded this species from Ithaca, N. Y. An examination of his specimens, which are all females, shows they are not *castaneus*.

Pocadicnemis Simon.

Ar. Fr. 5: 713. 1884.

Type: *Walckenaera pumila* Blackwall.

We include in this genus *hartlandiana* Emerton, which agrees fairly with the type species in the structure of the bulb and the armature of the tibia.

KEY TO THE SPECIES OF POCADICNEMIS, MALES.

Cephalothorax viewed from above with the ridges limiting the cephalic lobe short and divergent behind; dorsal margin of the tibia produced forward and armed with two stout, triangular processes. (Page 140)...**pumila**

Ridges limiting cephalic lobe long, concave; dorsal margin of the tibia broadly rounded with two small teeth on the lateral angle. (Page 139)...**hartlandiana**

Pocadicnemis hartlandiana Emerton.

(Plate V, Figs. 122–126.)

Lophocarenum hartlandianum Emerton. Conn. Acad. Sci. Trans. 18: 214, Pl. 1, Fig. 7. 1913.

Male.—Length, 1.3 mm. Cephalothorax dull yellowish orange, viewed from above evenly rounded on the sides without any constriction at the cervical groove, evenly and broadly rounded across the front. Sides of the cephalic lobe nearly parallel but slightly constricted at the pits; front margin of the lobe depressed medially. Posterior median eyes close together some distance from the front. Cephalothorax viewed from the side, steeply ascending behind and then nearly level

to the base of the cephalic lobe; the latter rather low, rounded behind, nearly level on top; median ocular area slanting forward; clypeus very slightly convex, slightly protruding. Cephalic pit small and situated some distance back of the posterior lateral eye and slightly above it in a furrow which runs from the eye to the cervical groove.

Posterior eyes in a strongly procurved line, the median almost touching but separated from the lateral by about one and one-half times the diameter. Anterior eyes in a slightly recurved line, the median smaller than the lateral, almost touching each other, separated from the lateral by the radius.

Sternum grayish orange-yellow, margin narrowly dark. Hind coxae separated by more than the diameter. Labium same color as sternum. Endites orange-yellow. Legs and palpi yellow-orange. Abdomen gray.

Femur of palpus short, nearly straight, somewhat thicker distally. Patella short, curved downward. Ratio of length of femur to that of patella as 14 to 5. Tibia short and very greatly widened distally. Dorsally it closely covers the base of the cymbium and dorsolaterally the margin is produced into two teeth separated by a narrow notch; the outer tooth is rounded at tip and the inner one ends in a black, sharp, recurved hook. Cymbium divided diagonally by a sharp ridge into two parts; the mesal part clothed with hairs and the lateral part smooth without hairs except for a narrow area along the lateral edge near base. When at rest the embolus lies along the ridge just mentioned. On the mesal side the cymbium is broadly and evenly excavated. Paracymbium strongly curved, widest in the middle and ending in a sharp, incurved point. Tegulum rather narrow with a very high bezel. The embolic division has a thin, rounded tail-piece which reaches to the edge of the tegulum close under the tip of the cymbium. From this arises directly the extremely long, slender, whip-lash-like embolus. It emerges from behind the bezel and makes a free loop over the end of the bulb, passes back along the ridge on the back of the cymbium to its base and then turns forward again in a sinuous course, the tip lying near the center of the basal turn of the embolus. The ejaculatory duct is closely attached to the embolus throughout its course by a thin membrane.

Type localities: Hartland, Vt. and Three Mile Island, Lake Winnepesaukee, N. H.

New Hampshire: Lake Winnepesaukee, May 15, 1911, 1 ♂. Emerton Coll. and det.

Pocadicnemis pumila Blackwall.

(Plate V, Figs. 127–131.)

Walckenaera pumila Blackwall. Linn. Soc. Lond. Trans. 18: 639. 1841.
Argus pumilus Walckenaer. Ins. Apt. 4: 508. 1847.
Walckenaera pumila Blackwall. Ann. Mag. Nat. Hist. (Ser. 2) 9: 466. 1852.
Walckenaera pumila Blackwall. Spid. Gr. Brit., p. 312, Pl. 21, Fig. 227. 1864.
Melicertus pumilus Simon. Hist. Nat. Ar. (Ed. I), p. 196. 1864.

Microneta bifida Menge. Preuss. Spin., p. 235, Fig. 134. 1869.
Erigone pumilus Thorell. Remarks on Synonyms, p. 452. 1873.
Walckenaera pumila Cambridge. Spiders of Dorset, p. 157. 1879.
Lophocarenum pumilum Bertkau. Naturh. Ver. Preuss. Rheinlande, Verh. 37: 305. 1880.
Lophocarenum longitubum Emerton. Conn. Acad. Sci. Trans. 6: 49, Pl. 13, Fig. 6. 1882.
Pocadicnemis pumila Simon. Ar. Fr. 5: 714, Figs. 582–586. 1884.
Pocadicnemis longituba Simon. Same. p. 178. 1884.
Pocadicnemis pumila Chyzer and Kulczynski. Aran. Hung. 2: 122, Pl. 4, Fig. 44, Pl. 5, Fig. 1, 1894.
Pocadicnemis pumila Bösenberg. Zoologica 14: 187, Pl. 16, Fig. 258. 1901–03.
Pocadicnemis pumila de Lessert. Cat. Ar. Suisse, p. 159. 1910.

Male.—Length, 1.5 mm. Cephalothorax yellowish suffused with gray, much darker on the head; cervical groove marked by a dark gray line. Cephalothorax viewed from above rather broad, rounded on the sides, the sides strongly convergent towards the front, rounded across the front. Cephalic lobe with the sides nearly parallel, slightly constricted at the pits. Cephalothorax viewed from the side moderately ascending behind and then nearly level to the base of the cephalic lobe; the latter moderately high, rounded over the back and top to the posterior median eyes; a depression between posterior median and anterior median eyes. Clypeus nearly straight, slanting forward. The cephalic pit close to the posterior lateral eye in a narrow groove.

Posterior median eyes situated at the front margin of the cephalic lobe. Posterior eyes in a procurved line, the median separated by two-thirds the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by the radius.

Chelicerae dull yellowish, lighter at tip. Sternum broad, convex, gray over yellow, darker at margin. Endites yellow, lightly suffused with gray. Hind coxae separated by the diameter. Legs yellow, tinged with orange. Abdomen light gray.

Femur of palpus cylindrical, gently curved inward. Patella short, as thick as femur, curved downward. Ratio of length of femur to that of patella as 17 to 7. Tibia as long as patella, not greatly widened distally; the dorsomesal margin produced into a rectangular process with the tip obliquely truncate; the lateral margin oblique and armed with a stout, black tooth. Cymbium angulate dorsally at base, the mesal margin deeply and broadly excavated, the tip truncate with the sides extending half way around the bulb. Dorsally a ridge extends the whole length of the cymbium; the part lying laterally from this ridge is flat, thin and devoid of hairs. Paracymbium small, broad at base, slender distally and moderately curved, without a distinct notch at tip. Tegulum narrow, bezel low, semitransparent. The embolus long, slender, whip-like; arising from a bulb-like base it makes one turn clock-wise passing down under the mesal edge of the tegulum and emerging at the bezel; it then curves over to the truncate end of the cymbium where it follows the edge from the mesal to the lateral angle. Median apophysis appears as a long, slender, curved, black process with the tip incurved.

Female.—Length, 1.6 mm. Similar to the male but usually more yellowish. Posterior eyes in a slightly procurved line, equidistant, the median a little larger than the lateral, separated by a little less than the diameter. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by the radius and a little farther from the lateral. Epigynum strongly convex, the median area smooth, rectangular. The middle lobe inverted T-shaped, the anterior arm slender and the posterior part inflexed.

Type locality: Llanrwst, Denbighshire, Wales.

England: Sussex, 2 ♂, 2 ♀ (Hancock). *France:* 2 ♂, 1 ♀ (Simon). *Hungary:* 1 ♂, 2 ♀ (Kulczynski). *New York:* Big Moose Lake, June 14, 1931, 1 ♂; Sylvan Beach, July, 1904, 3 ♀; Howard, July 5, 1924, 2 ♂, 4 ♀; Potter Swamp, July 16, 1926, 1 ♂, 5 ♀; Penn Yan, May 30, 1923, 2 ♂, 3 ♀; Cinnamon Lake, July 12, 1924, 1 ♂, 14 ♀, June 5, 1925, 5 ♂; Ithaca, May, 7 ♂, 8 ♀, August, 1904, 1 ♀, July, 3 ♀; Freeville, August 10, 1924, 3 ♀; Glens Falls, June 16, 1927, 2 ♂; McLean, June 17, 1923, 1 ♂, May 30, 1921, 4 ♂, 3 ♀ (heath bog), July, 1904, 3 ♀; June 13, 1922, 1 ♂, 3 ♀, June 21, 1924, 1 ♂; Vroomans Nose, May 15, 1921, 2 ♂; Voorheesville, June 19, 1923, 1 ♂, 1 ♀; Lake Charlotte, June 11, 1919, 3 ♂, 10 ♀; Schodack Landing, June 10, 1919, 2 ♂, 2 ♀; Riders Mills, May 22, 1921, 2 ♂; Ancram, June 11, 1919, 1 ♀; Little Pond, Orange Co., May 25, 1920, 15 ♂, 11 ♀; Wading River (Sound Beach), June 16, 1919, 1 ♂, 1 ♀; Baiting Hollow, May 31, 1923, 3 ♂, 4 ♀; Long Pond, Suffolk Co., June 29, 1924, 1 ♂; Montauk Point, June 25, 1927, 1 ♂. *New Hampshire:* Mt. Washington, July 1, 1874, ♂ Emerton, type; Intervale, July 18, 1913, ♂ (Bryant); June 1, 1909, 1 ♂ (Emerton). *Massachusetts:* Brookline, May 15, 1902, ♂ (Bryant). *Utah:* Verdure, May 18, 1928, 1 ♂ (Chamberlin). *Wyoming:* Old Faithful, Yellowstone Park, August 27, 1927, 1 ♂; *Alaska:* Mole Harbor, Admiralty Id. June 3, 1932, 1 ♂, 4 ♀ (A. Hasselborg).

Mythoplastoides new genus.

Type: *Lophocarenum exiguum* Banks.

In the male the cephalic lobe is fairly high and cephalic pits are present in the normal position. The embolic division is of the spiral type, with an elongate tail-piece and a style-like embolus which makes only about one turn. The tibia is armed with a long, stout process and is very deeply excavated.

We place these three species together because of the similarity in the structure of the bulb and the general plan of tibial armature.

KEY TO THE SPECIES OF MYTHOPLASTOIDES, MALES.

1. Median ocular area viewed from the side concave. (Page 143).....**abruptus**
   Median ocular area viewed from the side convex..... 2
2. Lateral erect process of tibia greatly widened at tip. (Page 145)....**exiguus**
   Lateral erect process of tibia not widened distally. (Page 144).....**erectus**

Mythoplastoides abruptus Emerton.

(Plate VI, Figs. 132–135.)

Lophocarenum abruptum Emerton. Conn. Acad. Sci. Trans. 14: 189, Pl. 3, Fig. 5. 1909.

Male.—Length, 2 mm. Cephalothorax orange-yellow, lightly suffused with gray, viewed from above elongate oval, rounded on the sides, pointed in front with a slight constriction at the cervical groove; clypeus with sides converging, truncate at tip. Cephalic lobe broadly rounded in front, constricted at the pits which are far forward, back of which the sides are rounded and convergent posteriorly. Posterior median eyes borne close to anterior margin of lobe when viewed from above. Cephalothorax viewed from the side moderately ascending behind with a broad and distinct depression at the cervical groove, ascending and rounded over the cephalic lobe to the posterior median eyes, a depression between the posterior median and anterior median eyes, the latter on a low protuberance. Clypeus very convex and protuberant. Cephalic pit situated back of and above the posterior lateral eye in a deep furrow which extends back to the cervical groove. Posterior eyes in a straight line, equidistant, the median slightly smaller than the lateral, separated by a little more than the diameter. Anterior eyes in a straight line, the median smaller than the lateral, almost touching, but separated from the lateral by the diameter.

Chelicerae yellow-orange, long, divaricate. Sternum yellow-orange strongly suffused with dusky, the margin narrowly black. Endites yellow-orange. Legs orange-yellow, femora and tibia of first and second legs broadly banded with dusky. Abdomen gray, the underside in front of the epigastric furrow pale.

Femur of palpus nearly straight, only slightly curved inward. Patella rather long, only slightly curved downward at base, thicker distally. Ratio of length of femur to that of patella as 21 to 14. Tibia short, provided with two long apophyses separated by a deep, semicircular notch; the dorsal apophysis is shorter and stouter, the mesal one longer, thinner, and lies close to the cymbium. Paracymbium rather thick, strongly curved and with a short, rounded hook at tip. Tegulum narrow but with the bezel high and conspicuous. Embolic division consists of a tail-piece which is not really coiled but has two bends; its tip is slender and reaches the edge of the tegulum. Embolus whip-like and makes one spiral turn; its base is enlarged to form a conspicuous bulb-like object just back of the bezel.

Type locality: Mt. Holyoke, Mass.

Massachusetts: Mt. Holyoke, June 20, 1906, the type, 1 ♂. *New York:* McLean, July 16, 1924, 1 ♂; Slaterville, August 3, 1924, 1 ♂; Riverhead, June 24, 1924, 1 ♂.

Mythoplastoides erectus Emerton.

(Plate VI, Figs. 136–141.)

Lophocarenum erectum Emerton. Conn. Acad. Sci. Trans. 20: 150, Pl. 2, Fig. 8. 1915.

Male.—Length, 1.5 mm. Cephalothorax dark brown, viewed from above rather broad, evenly rounded on the sides to the cervical groove, then converging towards the front, somewhat pointed in front; viewed from the side, rather steeply ascending behind and then almost level to the cervical groove; head strongly elevated, rounded over the back to the posterior eyes, then descending at a steep angle to the middle of the clypeus, which is strongly convex and somewhat protruding. A cluster of short, erect hairs in the median ocular area. Sternum broad, convex, smooth and shining, dull brown, strongly suffused with dusky, darker at the margin. Endites dusky yellow. Legs orange, coxae, patellae and base of tibia pale. Chelicerae dull yellow. Abdomen black.

Posterior eyes in a procurved line, equal, the median separated by the diameter and from the lateral by twice the diameter. Anterior eyes in a very slightly procurved line, the median only a little smaller than the lateral, subcontiguous, separated from the lateral by a little less than the diameter.

Femur of palpus rather slender, curved inward and upward. Patella rather short, widened distally. Ratio of length of femur to that of patella as 15 to 7. Tibia armed with two long processes, the dorsal process lies close to the cymbium, curves outward and ends in a thin edge; the other process arises near the base of the tibia on the dorso-lateral surface; it is erect, slightly curved forward and laterally and the margin is finely denticulate. The integument between the two processes is smooth, without hairs. Paracymbium small, strongly curved. The bezel high and pointed ventrally, the edge black. Tail-piece of the embolic division broad and flat, widened and obliquely truncate, the tip acute and extending beyond the edge of the tegulum. The embolus stout at base, becoming gradually more slender distally; it makes one spiral turn around the tip of the bulb, the tip is then turned back to form a small, open loop. The terminal part of embolus is widened by a broad band of transparent membrane.

Female.—Length, 1.9 mm. Similar to the male in color. Posterior eyes in a slightly procurved line, equal, equidistant, separated by a little less than the diameter. Anterior eyes in a procurved line, the median much smaller than the lateral, separated by two-thirds the diameter and from the lateral by the diameter. The epigynum consists of a convex, dark-colored plate, the middle lobe evenly rounded behind and angulate at the sides; its central part excavated to receive a club-shaped process projected from in front.

Type locality: Tackakaw Falls, Yoho Valley, B. C.

Alberta: Lake Louise, August 3, 1927, 2 ♂, 6 ♀ (sifted from moss). *Wyoming:* Grand Canyon, Yellowstone Park, August 30, 1927, 1 ♂ (sifted from moss).

Mythoplastoides exiguus Banks.

(Plate VI, Figs. 142–149.)

Lophocarenum exiguum Banks. Phila. Acad. Nat. Sci. Proc. 1892, p. 36, Pl. 5, Fig. 7.

Lophocarenum exiguum Emerton. Conn. Acad. Sci. Trans. 16: 391, Pl. 2, Fig. 2. 1911.

Male.—Length, 1.6 mm. Cephalothorax dull yellow-brown, narrowly margined with dusky; viewed from above noticeably short and broad, evenly rounded on the sides to the cervical groove where it becomes abruptly narrowed and tapers to the rather pointed front. Cephalic lobe yellow, suffused with dusky, high, short and narrow; its sides nearly straight and slightly converging posteriorly, evenly rounded behind, broadly rounded across the front. Cephalothorax viewed from the side gradually ascending to the cervical groove; head strongly and abruptly elevated, rounded over the back, nearly level on top and slanting forward slightly in front. Clypeus evenly and strongly convex, nearly vertical. Posterior median eyes borne on the top of the cephalic lobe.

Posterior eyes in a slightly procurved line, the median separated by the diameter and from the lateral by nearly three times the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by two-thirds the diameter and from the lateral by a little more than the diameter. Median ocular area much higher than wide. Chelicerae dull yellow. Sternum broad, dull brownish yellow, smooth and shining, darker at the margin, broadly produced between the hind coxae. Labium and endites dull yellowish white; the endites whitish distally. Legs and palpi dull yellowish, noticeably hairy. Abdomen gray, clothed with many long, stiff, light colored hairs.

Femur of palpus rather short, straight, not greatly widened distally. Patella short and broad, widened distally. Ratio of length of femur to that of patella as 13 to 7. Tibia short, the dorsal margin extraordinarily hollowed out and armed with two processes. The mesal process broad, flattened and strongly curved laterally and dorsally; the dorsal process erect, placed at some distance from the true margin of the segment and consists of an oblique, evenly curved ridge borne on a narrower base. The edge is bordered by a row of stiff hairs and the lateral angle ends in a smooth curved tooth. Paracymbium very small, flat and pointed at tip with a rounded notch on the inner side. Tail-piece of the embolic division rather small, thin and curved. The embolus proper has a bulb-like enlargement where it joins the tail-piece; it continues as a broad, flattened style becoming gradually slender. It curves over the end of the bulb to the tip of the cymbium and then turns laterally and ventrally, the tip lying in the hollowed-out tip of the bezel.

Female.—Length, 1.7 mm. Similar to male in form and color. Head normal. Posterior eyes in a slightly procurved line, the median a little larger than the lateral, separated by two-thirds the diameter and from the lateral by a little less. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by about the

radius and from the lateral by a little more. Spines on legs larger than in the male. Epigynum consists of a large, nearly flat plate, in the posterior edge of which there lies the small median lobe.

Described from the type, a male in the collection of the Museum of Comparative Zoology, Cambridge, Mass.

Type locality: Ithaca (Fall Creek), N. Y. 1 ♂.

Connecticut: Woodbridge, October 10, 1902, 3 ♂, 2 ♀ (Bryant).

Eridantes new genus.

Type: *Lophocarenum erigonoides* Emerton.

In this genus the males have cephalic pits. The embolic division of the bulb has a thin, flat tail-piece that gives rise directly to a rather stout style that makes only one small turn at the tip of the bulb.

We place *erigonoides* and *utibilis* together because of similarities in the cephalothorax and in the structure of the bulb, although there is considerable difference in the tibial armature.

KEY TO THE SPECIES OF ERIDANTES, MALES.

Tibia of palpus armed with a rather long, stout process. (Page 148).....**utibilis**
Tibia armed with a short, black, oblique tooth. (Page 146).....**erigonoides**

Eridantes erigonoides Emerton.

(Plate VI, Figs. 150–158.)

Lophocarenum erigonoides Emerton. Conn. Acad. Sci. Trans. 6: 50, Pl. 14, Fig. 3. 1882.
Erigone persicus Keyserling. Spinnen Am. Therid. 2: 153, Pl. 16, Fig. 219. 1886.
Lophocarenum parvum Banks. Phila. Acad. Nat. Sci. Proc. 1892, p. 36, Pl. 4. Fig. 6.
Lophocarenum formosum Banks. Same, p. 37, Pl. 4, Fig. 10.
Lophocarenum erigonoides Banks. Same, p. 37, Pl. 4, Fig. 9.
Diplocephalus erigonoides Simon. Hist. Nat. Ar. 1: 615. 1894.
Plaesiocraerius lobiceps Banks. Can. Ent. 29: 196. 1897.
Diplocephalus erigonoides Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 305.
Diplocephalus erigonoides Banks. Same, 1916, p. 74.
Caseola howardi Petrunkevitch. N. Y. Ent. Soc. Jour. 33: 175, Pl. 8, Fig. 10. 1925.

Male.—Length, 1.5 mm. Cephalothorax reddish orange with the cephalic lobe more yellowish and with the margin of the thorax, the sides of head and clypeus dark grayish. Cephalothorax viewed from above evenly rounded on the sides to the cervical groove where there is a very slight constriction, evenly and broadly rounded across the front. Cephalic lobe viewed from above with the sides parallel, gently rounded across the front; the posterior median eyes borne some distance from the front margin. Cephalothorax viewed from the side steeply ascending to the cervical groove in a nearly straight line, only slightly arched just back of the groove; a slight depression at the groove; cephalic lobe rather low, nearly level on top, rounded behind. Median ocular

area rounded. Clypeus nearly straight, slanting steeply forward. Cephalic pit very small, round, situated just behind and below the posterior lateral eye; furrow rather broad and deep. On the median line of the thorax just back of the head there are two very long, erect hairs.

Posterior eyes in a procurved line, the median separated by the diameter and from the lateral by a little more. The lateral eyes not visible from above, being hidden by the edge of the cephalic lobe. Anterior eyes in a procurved line, the median smaller than the lateral, equidistant, separated by the radius of the median.

Chelicerae dull yeliowish. Sternum orange suffused with dusky, the margin narrowly black. Hind coxae separated by the diameter. Endites yellowish suffused with gray. Legs and palpi yellow-orange. Abdomen nearly black.

Femur of palpus curved inward, only slightly thickened distally. Patella curved downward, thicker distally. Ratio of length of femur to that of patella as 16 to 8. Tibia short ventrally but broadly produced dorsally. The lateral part of this process is clothed with hairs but the mesal part is thin and smooth. The distal margin of the process is armed on the mesal angle with a sharp, black tooth curved laterally and bearing on its upper margin a series of small serrations; on the lateral angle there is a short, rounded process directed outward and armed with minute, short teeth. Paracymbium broad at base, pear-shaped with a small hook at tip; the basal part extends across the base of the alveolus reaching the base of the cymbium on the mesal side. Tegulum projecting strongly downward; margin of bezel nearly straight. Embolic division consists of a thin, flat, rounded tail-piece that extends to the edge of the tegulum and from which the embolus arises directly, the latter is a black rod, stout at base and slender at tip; it first turns towards the edge of the tip of the cymbium and then makes a rather sharp curve toward the bezel; the tip is turned inward and lies just inside the bezel.

Female.—Length, 1.7 mm. Very similar to the male. Trochanter and last two segments of palpus darkened. Posterior eyes in a procurved line, the median separated by the diameter and a little farther from the lateral. Anterior eyes in a gently procurved line, the median smaller than the lateral, separated by a little less than the radius and from the lateral by the diameter. Epigynum with the middle lobe very narrow in front and widened posteriorly; the median lobe is bounded laterally in front by what appears to be a pair of lobes rounded and convergent anteriorly.

Type locality: Beverly, Mass.

New Hampshire: L. Winnepesaukee, May 23, 1906, ♂ (Bryant); Chocorua, June 2, 1912, ♂ (Bryant); Moosilauke, July 8, 1912, ♂ ♀ (Bryant); Intervale, July, 1914, 1 ♀ (Bryant). *Massachusetts:* Beverly, May 24, 1874, ♂ Type; Readville, November 6, 1913, ♂ (Emerton). *Ohio:* Columbus, October 20, 1917, 3 ♂ (Barrows), April 13, 1918, 10 ♂, 17 ♀ (Barrows); Gambier, June, 1905, 3 ♀ (Nelson);

Delaware, August 5, 1905, 2 ♀; Salineville (Macgillivray). *Ontario:* Sanford, June, 1906, 1 ♀. *New York:* Mt. MacIntyre, July 1, 1923, 1 ♂, 1 ♀; Chapel Pond, Essex Co., July 19, 1924, 1 ♀; Olcott, February 1924, 1 ♂, 1 ♀ (Dietrich); Keuka Park, April, 1904, 1 ♂, 1 ♀; Crosby, November 1, 1914, 1 ♂, 1 ♀; Hammondsport, July 6, 1924, 1 ♂; Ithaca, November 1, 1925, 1 ♀, March, 1910, 1 ♀, December, 1 ♀; November, 1 ♂, May, 2 ♀, October 21, 1922, 1 ♂, 1 ♀ (ballooning); Esteys Glen, Cayuga Lake, May 22, 1912, 2 ♀; Etna, November, 1912, 2 ♀; McLean, September 28, 1912, 1 ♂; May 30, 1919, 1 ♀; Sacandaga Park, June 17, 1910, 1 ♂ (Alexander); Albany, June 26, 1926, 1 ♂; Middletown, April, 1904, 1 ♂; Tottenville, November 17, 1919, 1 ♀; Sheepshead Bay, September, 1911, 1 ♂, 1 ♀; Cold Spring Harbor, July 13, 1930, 1 ♀; Sea Cliff, June 13, 1919, 1 ♂; Long Pond, Suffolk Co., June 29, 1924, 3 ♂, 2 ♀; Baiting Hollow, May 31, 1923, 2 ♂, 1 ♀; Gardiners Island, May 25, 1924, 1 ♂, 1 ♀; Montauk Point, May 24, 1 ♀. *New Jersey:* Ft. Lee, 2 ♀ (Banks). *Illinois:* Urbana, 1 ♀ (Hyde); Chicago (Banks); Salts, October 11, 1925, 2 ♂, 2 ♀ (Smith); May 15, 1925, 1 ♀ (Smith), July 3, 1926, 1 ♀ (Smith). *Maryland:* Hagerstown, March, 1915, ♂ (Pennington). *District of Columbia:* February, 3 ♀ (Fox); Washington, 1 ♂, 1 ♀, from stomach of *Bufo fowleri;* no date, ♂ ♀ (Banks). *Virginia:* Falls Church ♂ (Banks). *Tennessee:* Beersheba, June, 1888, 1 ♂ (Fox); Clarkville, Type of *Caseola howardi* Petrunk, 1 ♀ (Crumb). *Minnesota:* Lake Minnetonka, July 31, 1924, 1 ♀ (Fletcher). *Iowa:* Traer, November 5, 1931, 1 ♀ (H. B. Mills). *Missouri:* Pierce City, March, 1906, 1 ♀; Mountain Groove, August, 1905, 1 ♂, 4 ♀; Columbia, October, 2 ♀, May, 2 ♂, 1 ♀, July, many of both sexes, June, 1 ♀, November, 1 ♂, 4 ♀. *Kansas:* Wathena, August, 1905, 1 ♀; Manhattan, June-November, 1924, 2 ♂ (R. C. Smith).

Keyserling recorded *persicus* from Baltimore, Md. Emerton recorded the species from Maniwaki, Que. Barrows recorded it from Columbus and Buckeye Lake, Ohio.

Eridantes utibilis n. sp.

(Plate VII, Figs. 159–164.)

Male.—Length, 1.5 mm. Cephalothorax dully yellowish, suffused with brownish; viewed from above, evenly rounded on the sides, very slightly constricted at the cervical groove, broadly rounded across the front, cephalic lobe rather broad with the sides almost parallel, broadly rounded across the front. Cephalothorax viewed from the side evenly and gently arched over the back to the posterior eyes with a very slight depression at the cervical groove. The median ocular area strongly concave. Clypeus gently convex and almost vertical. Cephalic lobe not greatly elevated, the pit oval and placed back of the posterior lateral eyes with which it is connected by a short, narrow groove. There is another broader, shallow groove which begins at the pit and eye and extends upward and backward, becoming narrower and ending in a shallow depression on the side of the cephalic lobe.

Posterior eyes in a slightly procurved line, the median separated by three times the radius and from the lateral by twice the diameter. Anterior eyes in a straight line, the median a little smaller than the lateral, separated by the radius and from the lateral by a little more than the diameter.

Sternum yellow strongly suffused with dusky, darker at the margin. Labium and endites lighter. Legs orange-yellow, patellae pale yellow. Abdomen dark gray.

Femur of palpus gently curved inward and somewhat widened distally. Patella slender and curved downward. Ratio of length of femur to that of patella as 14 to 6. Tibia viewed from above obconic, produced dorsolaterally into a stout, triangular apophysis which is darkened distally. The lateral margin of the apophysis finely dentate and armed with a distinct, black tooth. The paracymbium strongly curved and mostly hidden beneath the edge of the tibia. The tegulum strongly developed, the bezel high. The embolic division consists of a broad, flattened, strongly bent tail-piece which gives rise directly to a stout, black style that curves around the end of the bulb in a little less than one turn; its tip is flattened and ends in two points. The median apophysis appears as a rather long, slender, curved point, the tip of which lies under the tip of the embolus.

Holotype, male. Wilmington Notch, Essex Co., N. Y., Aug. 26, 1921.

New York: Paul Smiths, August 30, 1927, 1 ♂ (P. J. Chapman).

Dismodicus Simon.

Arachnides de France 5: 563. 1884.

Type: *Walckenaera bifrons* Blackwall.

The only American representative of this genus is very closely related to the type from which it differs in only minor characters.

Dismodicus decemoculatus Emerton.

(Plate VII, Figs. 165–169.)

Lophocarenum decemoculatum Emerton. Conn. Acad. Sci. Trans. 6: 46, Pl. 12, Fig. 4. 1882.
Neriene decemoculata Simon. Hist. Nat. Ar. 1: 633. 1894.
Dismodiscus decemoculatus Banks. Can. Ent. 38: 63. 1896.
Oedothorax decemoculatus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 311.
Lophocarenum decemoculatum Emerton. Conn. Acad. Sci. Trans. 16: 393, Pl. 2, Fig. 7. 1911.
Lophocarenum decemoculatum Emerton. Royal. Can. Inst. Trans. 12: 314. 1919.

Male.—Length, 2 mm. Cephalothorax bright orange-yellow, lighter on the cephalic lobe; viewed from above elongate oval, rounded on the sides, convergent in front to a rounded point in front of the eyes; cephalic lobe shallowly canaliculate; viewed from above semicircularly rounded in front; cephalothorax viewed from the side steeply ascending to the

cephalic groove, then abruptly elevated and rounded over the high cephalic lobe to the posterior median eyes which are on the front face of the lobe. Front of head flat and vertical; all of the eyes borne on this face. The cephalic lobe is excavated on the side back of the posterior median eyes and the top of the lobe curves down over the cavity. At the anterior corner of the excavation there is an ovate yellowish spot, pointed behind and about the size of an eye. The integument seems to be intact over this spot and it does not seem to be a true pit. Clypeus strongly protuberant in the middle.

Posterior median eyes in a slightly recurved line, the median slightly smaller than the lateral, separated by the diameter. Anterior eyes in a straight line, the median nearly as large as the lateral, separated by the radius and from the lateral by the diameter. Clypeus slightly wider than the median ocular area. No tooth on the face of chelicera.

Sternum orange-yellow, narrowly dusky at margin, rather broad, rounded on the sides, produced between the hind coxae in a broad truncate point. Hind coxae separated by the diameter. Labium dusky. Endites yellowish, paler distally. Legs orange-yellow, patellae lighter, tibiae and metatarsi dusky. Abdomen dark gray, almost black.

Femur of palpus rather short, somewhat curved, widened distally. Patella long, rather strongly widened distally. Ratio of length of femur to that of patella as 17 to 10. Tibia short, wide distally, the mesal half of the dorsal margin smooth, gently rounded, the lateral half excavated and armed with a stout, black, blunt-pointed tooth, gently curved outward. Paracymbium strongly curved and hooked. Subtegulum large. Bezel high and produced into a membranous rounded point near the tip of the palpus. Tail-piece of the embolic division broad, thick and rounded at tip. The apical part of the embolus emerges from the edge of the bezel as a black curved style which makes one-half of an open spiral turn at the end of the bulb.

Female.—Length, 2.7 mm. Cephalothorax usually with a narrow dark stripe through the dorsal groove, head normal. Posterior eyes in a slightly recurved line equal, median separated by the radius and from the lateral by the diameter. Anterior eyes in a slightly recurved line, the median smaller than the lateral, separated by less than half the radius and from the lateral by the radius. Clypeus as wide as median ocular area. Legs orange-yellow; the tibia and metatarsi dark gray; the tarsi lighter gray. Middle lobe of epigynum inverted T-shaped, each arm thickened on the front side; the longitudinal part narrowed posteriorly.

Type locality: Mt. Washington, N. H.

New York: Newcomb, July, 1918, 1 ♀; Ithaca, May, 1 ♂. *Manitoba:* LePas, July 1, 1917, 1 ♂, 1 ♀ (Emerton).

This species has also been recorded by Emerton from Quebec: Lake Megantic; Montfort; Ontario: Ottawa; Minaki; Manitoba: LePas, July 1, 1912, 2 ♂ 2 ♀; Dauphin; Aweme; British Columbia: Laggan, 5,000 ft.

This species is very closely related to *Dismodicus bifrons* Blackwall, but the tibia of the male palpus is relatively shorter and the dorsolateral process is wider, thinner, and broadly truncate at tip. In other respects the palpi are almost identical.

Horcotes new genus.

Type: *Lophocarenum quadricristatum* Emerton.

Among the types of European genera we have examined there are only two, *Anacotyle stativa* Simon and *Nothocyba subaequalis* Westring, in which the embolic division has the tail-piece long and spirally twisted as in Ceraticelus and Grammonota.

In Horcotes the tail-piece is long and spirally twisted and the embolus is a long, slender style which makes one complete turn around the end of the bulb. The cephalic lobe of the male is fairly high. The cephalic pits are in the normal position. The median ocular area is ornamented by two pairs of peculiar comb-like structures.

Horcotes quadricristatus Emerton.

(Plate VII, Figs. 170–176.)

Lophocarenum quadricristatum Emerton. Conn. Acad. Sci. Trans. 6: 48, Pl. 13, Fig. 3. 1882.

Lophocarenum quadricristatum Emerton. Conn. Acad. Sci. Trans. 14: 189, Pl. 3, Fig. 4. 1909.

Male.—Length, 2 mm. Cephalothorax dull yellow, strongly suffused with dusky, darker at the margin and with an irregular network of dark lines. Viewed from above, evenly rounded on the sides to the cervical groove where there is a slight constriction, then gradually converging to the truncated front. The cephalic lobe widest in front where it originates back of the anterior lateral eyes, then gradually converging toward the rear, with the sides serrate. In front of the posterior median eyes a broad, divergent comb-like structure with the free-edge curved downward, apparently formed by the fusion of about twenty hairs; in front of this structure and opposite the posterior lateral eyes, a smaller but similar structure. Cephalothorax viewed from the side rather steeply ascending behind, then flattened for a short distance at the cephalic groove. Cephalic lobe low, steeply ascending behind then gradually rounding over to the posterior median eyes. Pit shallow, immediately behind the posterior lateral eyes in a groove that is limited above by a definite ridge.

Posterior eyes in a very strongly procurved line, about equal, the median on the cephalic lobe, separated by a little more than the diameter and from the lateral by two and one-half times the diameter. Anterior eyes in a recurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by the diameter. Anterior lateral eyes largest.

Sternum orange, strongly suffused with dusky, darker at the margins, broad, convex, smooth and shining, broadly produced between the hind coxae. Labium dark brown. Endites dull yellow with scattered grayish patches. Legs and palpi dirty yellow, coxae darker distally. Abdomen dark gray.

Femur of palpus moderately long and slender, not noticeably widened distally, curved inward and armed ventrally with a median series of long curved hairs. Patella short, somewhat widened distally. Ratio of length of femur to that of patella as 11 to 5. Tibia narrow basally, greatly widened and produced dorsolaterally into a long, pointed, triangular process; dorsally there is a long, strong, folded and fluted apophysis directed obliquely across the back of the cymbium. Paracymbium stout, curved and hooked at tip. Tegulum wide, bezel not greatly produced. Tail-piece of the embolic division long and straight, flattened and somewhat widened near the tip which lies near the base of the cymbium on the mesal side. Embolus a long, stout, black, style which makes two complete turns around the end of the bulb. The first turn the reverse of the second.

Female.—Length, 2 mm. Similar to male in form and color. Arrangement of eyes much as in the male. Posterior eyes in a strongly procurved line. The median slightly larger than the lateral, separated by a little more than the diameter, a little closer to the lateral. Anterior eyes in a recurved line, the median one-half the diameter of the lateral, separated by a little less than the radius and from the lateral by the radius.

Epigynum a strongly convex plate, narrow in front and wide along the epigastric furrow. The median fovea a broad, shallow emargination, which is occupied by the middle lobe.

Described from the types in the Museum of Comparative Zoology, Cambridge, Mass.

Type locality: Mt. Washington, N. Y. 1 ♂, June 11, 1877.

New Hampshire: Mt. Washington summit, 1 ♂, 1 ♀, July 1, 1926. (N. Banks).

Baryphyma Simon.

Arachnides de France 5: 694. 1884.

Type: *Walckenaera pratensis* Blackwall.

The following notes on *B. pratensis* are based on specimens from England received from Mr. Richard Hancock.

Male.—Cephalothorax viewed from above broad, evenly rounded on the sides, with a broad constriction at the cervical groove, broadly rounded across the front. Cephalic lobe low, broadly rounded across the front, the sides slightly convex and converging posteriorly.

Cephalothorax viewed from the side gradually ascending behind to the cervical groove where there is a slight depression, then gently

rounded over the very low head. Median ocular area nearly straight, slanting forward. Clypeus convex and slightly protruding. Cephalic pit small, round, placed slightly above and behind the posterior lateral eye at the anterior end of a narrow groove that extends backward nearly to the end of the cephalic lobe.

Posterior eyes in a very slightly procurved line, the median slightly smaller than the lateral, separated by the diameter, much farther from the lateral. Anterior eyes in a slightly recurved line, the median smaller than the lateral, separated by two-thirds the diameter and from the lateral by nearly twice the diameter.

Tibia of palpus very short, the thin dorsal margin slightly produced into a wide, triangular tooth from which a long, thin, slender process extends laterally. Tail-piece well developed, erect, giving rise directly to a long, style-like embolus which passes up along the mesal side of the bezel and makes a loop of one turn around the end of the bulb. Median apophysis appears as a stout process extending out of the center of the coil of the embolus.

Baryphyma longitarsum Emerton.

(Plate VII, Figs. 177–180.)

Lophocarenum longitarsus Emerton. Conn. Acad. Sci. Trans. 6: 48, Pl. 13, Fig. 4. 1882.
Lophomma longitarsum Simon. Ar. Fr. 5: 538. 1884.
Lophomma longitarsum Simon. Hist. Nat. Ar. 1: 659. 1894.
Lophomma longitarsum Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 306.

Male.—Length, 1.8 mm. Cephalothorax dark reddish brown, viewed from above rather broad, rounded on the sides posteriorly, the sides convergent towards the front, broadly rounded across the front; viewed from the side ascending and gently arched over the back to the top of the head back of the posterior median eyes with a slight depression at the cervical groove. Clypeus gently convex and slanting forward. Due to the great development of the chelicerae the whole cephalothorax is inclined at a steep angle.

Posterior eyes in a straight line, the median separated by two-thirds the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by one-third the diameter and from the lateral by two-thirds the diameter. Cephalic pits close behind and slightly above the posterior lateral eyes, small, not in distinct grooves. Sternum finely rugose, orange strongly suffused with gray and narrowly margined with dark brown, rather broad, convex, produced posteriorly into a truncate point between the hind coxae which are separated by the diameter. Labium same color as edge of sternum. Endites orange-yellow armed with a few small setigerous tubercles. Chelicerae greatly swollen basally, divaricate, with strong teeth at the inner angle, and a single black tooth near the middle of the upper margin. Claw very long. Face of chelicerae with numerous small setigerous tubercles. Legs and palpi yellow-orange, patellae and a narrow ring at base of tibia pale. Abdomen gray.

Femur of palpus, slender, gradually thicker distally, strongly curved inward. Patella short and rounded above. Ratio of length of femur

to that of patella as 25 to 7. Tibia longer than patella, swollen distally, the dorsal margin provided with a short, rather blunt tooth. Laterally from the tooth the margin has a shallow, smoothly rounded emargination.

Paracymbium rather large, strongly bent, scythe-shaped, the basal half hairy, the rest thin and semitransparent. Bezel elongate, the edge smoothly rounded, the end towards the tip of tarsus membranous. The embolic division consists of a short, twisted tail-piece which stands erect at the base of the bulb. From this the embolus arises directly as a flattened, grooved rod which curves up across the ventral face of the bulb and passes around back of the bulb under the cymbium, emerging on the lateral side where it forms a loop lying on the end of the bulb and then again passes under the edge of the cymbium. The tip of the embolus which is very fine may be seen on the inner side of the bezel between it and the first turn of the basal part of the embolus.

Type locality: White Mts. near Mt. Washington, N. H.

New Hampshire: Mt. Washington, Je. 1877, ♂, type (Emerton); Base Station, Mt. Washington, August 18, 1925, 1 ♂. *New York:* Wilmington Notch, August 21, 1916, 1 ♂; Montauk Point, May 24, 1924, 1 ♂; Prattsburg, July 16, 1926, sifted from moss; Mt. Whiteface, August 25, 1921, 1 ♂; Adirondack Lodge, July 24, 1925, 1 ♂.

While this species bears a superficial resemblance to *Lophomma punctatum* Blackw. in the form of the cephalothorax and the armature of the chelicerae, it differs so greatly in the structure of the embolic division of the palpal organ that they cannot be considered congeneric. In *L. punctatum* the tail-piece is a flat plate and the embolus is a short, curved hook, shorter than the width of the tail-piece.

Origanates new genus.

Type: *Lophocarenum rostratum* Emerton.

The head of the male is strongly elevated and projects forward in a pointed beak carrying the posterior median eyes on its upper surface. The tail-piece of the embolic division is long and enlarged at tip. The embolus is styliform, making one turn around the tip of the bulb; at its base there is a large, oblique tooth. The median apophysis serves as a conductor for the tip of the embolus. The tibia is armed with a very long dorsal apophysis.

Origanates rostratus Emerton.

(Plate VII, Figs. 181–185.)

Lophocarenum rostratum Emerton. Conn. Acad. Sci. Trans. 6: 49, Pl. 14, Fig. 1. 1882.
Trachelocamptus rostratus Simon. Hist. Nat. Ar. 1: 629. 1894.
Trachelocamptus rostratus Crosby. Phila. Acad. Nat. Sci. Proc. 1905, p. 334.

Male.—Length, 1.3 mm. Cephalothorax dusky orange-yellow with a light rectangular area back of the cephalic lobe, the latter darker than the rest. Cephalothorax viewed from above rather long, evenly rounded on the sides, narrowed towards the front, broadly rounded across the front; the cephalic lobe produced forward into a conical point, the sides back of the lateral eyes nearly straight and parallel. The tip of the cephalic lobe clothed on the sides with a group of recurved hairs increasing in length posteriorly. The posterior median eyes placed on the top of the lobe about a third of its length from the front. Thoracic part has the surface finely reticulate. Cephalothorax viewed from the side moderately ascending behind to the cervical groove where it is almost flat, then evenly and gently rounded over to the tip of the cephalic lobe which projects forward beyond the clypeus. Cephalic pit large, oval, placed immediately behind the posterior lateral eye, not in a definite groove. Clypeus concave immediately below the eyes, then convex and slightly protruding.

Posterior eyes in a slightly recurved line, the median slightly oval, separated by the transverse diameter and from the lateral by three times the radius. Anterior eyes in a recurved line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

Sternum broad, finely reticulated, convex, gray over dull yellow, the margin narrowly darker. Endites dull orange-yellow. Legs dusky orange-yellow. Abdomen gray.

Femur of palpus rather short and stout, curved downward. Patella long, straight, widened distally. On each side of patella there is a row of four long, slender hairs directed forward. Ratio of length of femur to that of patella as 16 to 11. Tibia short, greatly widened distally; the mesal angle produced into a very long, slender, gently curved apophysis. The tip is widened, obliquely truncate and minutely dentate on the truncate edge. Dorsal margin of the tibia is broadly, shallowly, and evenly emarginate, the lateral margin evenly rounded. Paracymbium short, bent at a right angle, with a small, square hook at the tip. The bezel high and pointed. The tail-piece of the embolic division enlarged at tip into a broad, rounded lobe that overlies the tegulum; basally it is more narrow and gives rise directly to a black styliform embolus which makes one turn around the end of the bulb, its tip projecting forward under the protection of a narrow, pointed, blackish conductor which is in fact the median apophysis. At the base of the embolus there is a large, oblique, black, sharp tooth.

In a specimen from Blue Mound, Kansas, the palpi are naturally expanded. The tip of the palpal organ is turned back so that it lies in the emargination laterad of the long dorsal tibial apophysis. The coil of the embolus lies against the lateral side of the tibial apophysis; its terminal part is held between the base of apophysis and the cymbium and its tip projects on the mesal side of the apophysis. The sharp, black tooth at the base of the embolus lies at the margin of the tibia in the emargination. Laterally from the coil of the embolus there is a narrow, pointed process directed backward; this process is a branch

arising from the inner side of the tail-piece and is not visible in the unexpanded bulb. Its function is, apparently, to hold the embolus against the tibial apophysis. The conductor is held out of the way by the paracymbium and the tip is directed upward away from the base of the tibia.

Female.—Length, 1.2–1.7 mm. Similar to the male in color. Posterior eyes in a straight line, the median separated by the diameter and from the lateral by two-thirds. Anterior eyes in a slightly recurved line, the median smaller than the lateral, separated by the radius and from the lateral by two-thirds the diameter. The epigynum consists of a convex plate without any openings on the surface. The receptacles show through as oval, brownish spots separated by the diameter.

Type locality: New Haven, Conn.

Connecticut: New Haven, October 9, 1881, ♂, Type (Emerton). *Massachusetts:* Brookline, November 22, 1904 (Bryant); Carlisle, October 26, 1907 (Bryant); Readville, November 6, 1913, (Emerton). *New York:* Ithaca, March, 1 ♂; Olcott, September 19, 1925, 1 ♂, 1 ♀, October, 1924, 1 ♂ (Dietrich); September, 1922, 2 ♂; Great Pond, Riverhead, May 23, 1924, 11 ♀; April 11, 1923, 1 ♂; Baiting Hollow, May 31, 1923, 2 ♀; Southold, April 11, 1923, 1 ♂, 6 ♀; Cold Spring Harbor, April 10, 1905, (Bryant); Sea Cliff (Banks). *Pennsylvania:* Roxbury, October 30, 1924, 9 ♂, 8 ♀; Sterrets Gap, between Carlisle and Bloomfield, October 31, 1924, 2 ♂, 7 ♀. *Virginia:* Great Falls, April 3, 1921, 2 ♀; Alberta, October 27, 1923, 2 ♀; Roanoke, October 7, 1923, 3 ♂, 1 ♀; Rocky Mount, October 8, 1923, 1 ♂. *North Carolina:* Raleigh, October 26, 1923, 2 ♂, 1 ♀; Madison, October 8, 1923, 1 ♀; Hendersonville, October 18, 1923, 2 ♂, 6 ♀; Blowing Rock, October 10, 1923, 1 ♂, 1 ♀; Oteen, October 16, 1923, 11♂, 12 ♀; Minehole Gap, Buncombe Co., October 17, 1923, 7♂, 4 ♀. *Georgia:* Top of Blue Ridge on line between Towns and Rabun Counties, October 18, 1926, 5 ♂, 1 ♀; Tallulah Falls, October 18, 1926, 2 ♂. *Ohio:* Sugar Grove, December 26, 1915, 2 ♂, 1 ♀ (Barrows), Emerton det. *Missouri:* Columbia, November, 21♂, 13 ♀; March, 1906, 8 ♂, 27♀, February, 1905, 2 ♀, October, 11 ♂, 15 ♀, June, 4 ♂, 3 ♀. *Kansas:* Blue Mound, Douglas Co., 2 ♂ (Beamer). *District of Columbia:* November, 1♂. *Maryland:* Bayshore Park, Baltimore, December 29, 1918, 1 ♂; College Park, November 6, 1931, 1 ♂, 5 ♀.

Hybocoptus Simon.

Arachnides de France 5: 768. 1884.

Type: *Erigone decollatus* Simon.

The following notes on *H. decollatus* are taken from a specimen from France determined by Simon.

Male.—Cephalothorax viewed from above evenly rounded on the sides with scarcely a constriction at the cervical groove, bluntly rounded across the front. Cephalic lobe broadly ovate, a little narrower in

front. The posterior median eyes are near the front of the lobe. Median ocular area heavily clothed with divergent hairs. Cephalothorax viewed from the side rather steeply ascending behind to the cervical groove where there is a slight depression and then ascending gently to the base of the cephalic lobe the back of which is nearly vertical, evenly and broadly rounded over the top and front of the cephalic lobe to the deep transverse groove crossing the median ocular area. Cephalic pit small, round, some distance behind and slightly above the posterior lateral eye in a broad groove limited above by a sharp ridge. Clypeus slightly convex and protruding. Sternum broad, convex, slightly produced laterally, widely produced between the hind coxae.

Posterior eyes in a straight line, median separated by three times the radius and from the lateral by four times the diameter. Anterior eyes in a straight line, equal, separated by a little less than the diameter and from the lateral by three times the radius. Femur of palpus moderately long and rather stout. Patella stout, somewhat widened distally. Ratio of length of femur to that of patella as 20 to 10. Tibia very convex dorsally, the dorsal margin smooth and without hair, incurved; the mesal margin with a deep rounded emargination; the lateral margin with a shallow, rounded emargination and with a narrow black border dorsally from which there is an almost transparent, thin, triangular tooth. Paracymbium very strongly curved. Tail-piece of the embolic division rather short and rounded, giving rise on the inner side to a long, style-like embolus which emerges on the lateral side of the bulb, curves to the tip of the cymbium and then downward so that the tip lies inside the bezel.

We place in this genus *Lophocarenum dentipalpis* Emerton because of the close similarity in the structure of the bulb and in spite of the difference in the form of the head and the position of the posterior median eyes.

Hybocoptus dentipalpis Emerton.

(Plate VIII, Figs. 186–193.)

Lophocarenum dentipalpis Emerton. Conn. Acad. Sci. Trans. 20: 149, Pl. 2, Fig. 9. 1915.

Diplocephalus wamotsus Chamberlin. Ent. Soc. Am. Ann. 12: 251, Pl. 18, Figs. 6–7. 1919.

Male.—Length, 2.6 mm. Cephalothorax brownish yellow, rather broad and flat posteriorly; head strongly and abruptly elevated; viewed from above, evenly rounded on the sides to the cervical groove where there is a slight constriction, gradually converging to the bluntly rounded front; viewed from the side, gently ascending behind to the back of the cephalic lobe, then more steeply ascending over the back of the lobe, bluntly rounded over the front to the posterior median eyes. Just back of and to the side of the posterior median eyes there is on each side a blunt yellowish lobe projecting forward and slightly upward. Just below this lobe is a groove and the pit lies just above and a little behind the posterior lateral eye. The top of the head between

the lobes is rounded in profile and descends in a straight line to the anterior median eyes. Clypeus convex and vertical. Chelicerae strongly retreating.

Posterior eyes in a strongly procurved line, the median about their diameter apart but widely separated from the lateral. Posterior median eyes directed forward and upward. Anterior eyes in a straight line, the median separated by two-thirds the diameter but widely separated from the lateral. Face hairy; back of the posterior eyes long hairs project forward; between the posterior and anterior median eyes the hairs are directed towards the sides, parted in the middle; on the clypeus they are pointed upward.

Legs and palpi pale brownish yellow. Tarsi of first and second legs slightly fusiform. Posterior coxa with a sharp angle behind. Sternum dark grayish brown. Posterior coxae near together. Endites and chelicerae brownish yellow.

Patella of palpus short, only a little enlarged distally. Tibia much longer and wider than the patella and hollowed out into a thin cup. Arising from behind the dorsal margin, on the inside, there is an oblique short tooth, the tip of which appears beyond the margin of the tibia. Paracymbium short and strongly curved without distinct hook at tip. Tegulum narrow, the bezel transverse, margin sinuate. The tail-piece of the embolic division rather small, curved and pointed, lying close to the jet-black edge of the tegulum. The base of the tail-piece lies under the edge of the cymbium and gives rise to a long, slender, black, style-like embolus, the basal part of which lies between the back of the bulb and the cymbium; it emerges on the lateral side of the cymbium and is looped over the end of the bulb, the tip lying in a notch of the bezel. The median apophysis is in two parts, the distal margin of the tegulum is continued as a flat, thin style which follows the curve of the embolus in its course under the cymbium, the tip is pointed and lies completely hidden under the edge of the cymbium. The proximal part of the tegulum is broadened, thickened and grooved and appears just back of the bezel, ending in two or three points.

Female.—Length, 2 mm. Similar to male in form but in general lighter in color. Head normal; abdomen dull yellowish white; legs light; sternum pointed behind as in the male. Posterior eyes in a procurved line, equal, the median separated by three-fourths the diameter and from the lateral by about twice the diameter. Anterior eyes in a nearly straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by twice the diameter.

Epigynum has an oval opening divided by a septum.

Male described from the type in the Museum of Comparative Zoology, Cambridge, Mass.; female from a specimen collected by Chamberlin at Chalk Creek, Utah.

Type locality: Jasper, Alberta, Canada. Goat Mt., moss in highest trees. August 18, 1914. (Emerton).

Utah: Chalk Creek, 4 ♂, 6 ♀ (R. V. Chamberlin).

Symmigma new genus.

Type: *Lophocarenum minimum* Emerton.

In this genus the male has the cephalic pit in normal position and the head is only moderately elevated. The embolic division has a long, distinct tail-piece, the embolus is curved spirally and is widened by a semitransparent membrane at the corner of which the duct opens.

Symmigma minimum Emerton.

(Plate VIII, Figs. 194–198.)

Lophocarenum minimum Emerton. Can. Ent. 55: 243, Fig. 8. 1923.

Male.—Length, 1.2 mm. Cephalothorax bright orange-yellow, lighter on the anterior and posterior ends of the cephalic lobe; viewed from above, evenly rounded on the sides and broadly rounded across the front, without a constriction at the cervical groove; viewed from the side steeply ascending behind to the cervical groove, then broadly rounded to the posterior eyes. The cephalic lobe viewed from above broadly and evenly rounded across the front, the sides nearly parallel but slightly convex. The posterior median eyes placed their radius from the front of the lobe. The cephalic pit, small and round, placed close above and behind the posterior lateral eyes, in a deep groove widest in front. Clypeus nearly straight and slightly protruding.

Posterior eyes in a procurved line, the median separated by a little more than the diameter and from the lateral by three times the radius. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by the diameter.

Sternum orange-yellow, lightly suffused with dusky, convex, smooth and shining. Endites same color. Legs light orange-yellow. Abdomen light gray.

Femur of palpus moderately long, widened distally, curved inward. Patella short and straight. Ratio of length of femur to that of patella as 12 to 5. Tibia short and obconic, dorsally produced into two processes, the mesal one longer, straight and pointed, the lateral one shorter, strongly incurved. The notch between the two processes evenly rounded. The margin of the mesal process clear and thin, but there is a dark line on the mesal side of the lateral process which curves around back of the margin of the notch and is easily mistaken for the edge when viewed at certain angles. Paracymbium thin, flat, and strongly curved. The tegulum strongly produced and angulate ventrally, the bezel very high. Tail-piece of the embolic division terminates in a broad, rounded lobe which overlies the edge of the tegulum, basally it is more slender and gives rise to a slender black, styliform embolus which fits in a notch in the bezel and then makes a spiral of almost one complete turn. Throughout the spiral, the embolus is accompanied on the inside by a broad band of membrane, on the inner edge of which lies the ejaculatory duct.

Type locality: Terrace, B. C.

We have studied two males from the type lot given us by Mr. Emerton.

Dietrichia new genus.

Type: *D. hesperia* n. sp.

In this genus the cephalic pits are directly back of the posterior lateral eyes, the head is moderately elevated. The tibial apophysis is a long, single, stout process. The tail-piece of the embolic division is large and rounded and gives rise to a nearly straight, basally stout, apically slender, style-like embolus.

We establish a new genus for this species because we can find no genotype which possesses this type of genital bulb.

Dietrichia hesperia n. sp.

(Plate VIII, Figs. 199–204.)

Male.—Length, 1.7 mm. Cephalothorax brownish over dull yellow; viewed from above rather elongate, only gently rounded out on the sides, a slight constriction at the cervical groove, broadly rounded across the front. Cephalic lobe with sides straight, slightly converging with a slight constriction at the pits. Posterior median eyes borne a short distance from the front of the lobe. Cephalothorax viewed from the side rather steeply ascending behind to the cervical groove; it is almost straight for a short distance, then very gently rounded over the head to the posterior eyes. Median ocular area slanting steeply downward. Clypeus gently convex and slightly protruding. Cephalic lobe low. Cephalic pit on the level of and behind the posterior lateral eye, located in a shallow furrow. Median ocular area clothed with stiff, divergent hairs.

Posterior eyes in a slightly procurved line, equal, the median separated by two-thirds the diameter and from the lateral by one and one-third times the diameter. Anterior eyes in a recurved line, the median smaller than the lateral, separated by the radius and from the lateral by three times the radius.

Chelicerae dull yellow-orange, armed on the inner face near the tip of the claw with a cluster of three small, setigerous tubercles. Sternum orange, lightly and evenly suffused with gray, darker at the margin. Labium gray. Endites orange-yellow. Legs and palpi yellow-orange. Abdomen gray.

Femur of palpus long, strongly curved inward and distinctly thickened distally. Patella short, curved downward, thickened distally. Ratio of length of femur to that of patella as 23 to 8. Tibia armed on the dorsolateral margin with a long, rather stout, nearly straight process. The process is gently convex on the mesal side, straight on lateral side and obtusely angulate towards base; on the side next to the cymbium near tip is a small but distinct black tooth. Paracymbium rather broad and very strongly curved. Bezel very high and extended into a pointed membranous process which serves as a conductor for the protection of the tip of the embolus. The embolic division consists of a very large, rounded tail-piece from which the embolus arises at a right angle as a stout, black, nearly straight stylus which ends in a sharp point directed towards the tip of the palpus.

Female.—Length, 1.7 mm. Similar to the male in form and color. Posterior eyes in a slightly procurved line, equal, the median separated by a little less than the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median slightly smaller than the lateral, subcontiguous, separated from the lateral by two-thirds of the diameter. The epigynum consists of a squarish plate strongly chitinized in front to form a transverse plate the posterior edge of which, in the middle, is raised and covers the narrow anterior part of the middle lobe; the latter gradually widens posteriorly, then more abruptly to make the lobe T-shaped.

Holotype, male; allotype, female, Northfork, Cal., March, 1920 (H. Dietrich), paratypes, 1 ♂, 1 ♀.

Hormathion new genus.

Type: ***Hormathion limnatum*** n. sp.

This genus is closely related to Origanates in the structure of the embolic division, but the tibia is armed with a very short process and the head is squarish in front, not produced into a beak.

Hormathion limnatum n. sp.

(Plate VIII, Figs. 205–210.)

Male.—Length, 1.6 mm. Cephalothorax dull yellow-orange, radiating lines darker, head lighter. Cephalic lobe and area extending to dorsal furrow smooth, rest of cephalothorax finely reticulate. Cephalothorax viewed from above rounded on the sides, the sides converging forward, rounded across the front with the anterior median eyes in profile; cephalic lobe rather short, with a longitudinal groove, the front margin notched in the middle, anterior angles rounded, the sides concave and divergent posteriorly. The posterior median eyes borne some distance from the front margin on top of lobe. Cephalothorax viewed from the side steeply ascending behind, then rounded over to cervical groove where there is a distinct depression; cephalic lobe rounded over the back, nearly flat on top, and vertical in front with the anterior angle rounded. The anterior median eyes in profile. Clypeus nearly straight and distinctly retreating. Cephalic pit round, close to posterior lateral eye in a broad groove which runs out before reaching the cervical groove.

Posterior eyes in a procurved line, the median close together some distance from the anterior margin of the cephalic lobe, separated by the diameter and from the lateral by more than twice the diameter. Anterior eyes in a straight line, the median much smaller than the lateral, almost touching but separated from the lateral by more than the diameter.

Chelicerae yellow-orange. Sternum orange-yellow, finely reticulate. Endites same color, nearly white at tip. Legs and palpi orange, patellae pale. Abdomen gray.

Femur of palpus rather short, nearly straight. Patella more slender than femur, slightly curved downward. Ratio of length of femur to

that of patella as 17 to 8. Tibia with the dorsal margin produced into two points; when viewed from above the dorsal apophysis appears slender and acute but in side view it is broad, rectangular, with the distal angles rounded and the margin with a small notch. The lateral apophysis is shorter, sharper, and has the tip incurved. Between the apophysis the margin appears in dorsal view to be notched in an obtuse angle and is finely dentate but when viewed from in front the notch appears rounded. Paracymbium short and broad with a short, rounded hook at tip. Tegulum somewhat protuberant ventrally. Bezel broad, low and with a membranous edge. The embolic division consists of a thin, slender tail-piece which extends to the edge of the tegulum. At the base of the tail-piece there is a bulb-like enlargement from which arises the whip-like embolus. The latter is not coiled, but curves downward to the bezel and the tip is recurved. The bulb-like enlargement also bears a rather long, very slender, black-tipped spine.

Female.—Length, 1.8 mm. In general appearance similar to the male. Posterior eyes in a procurved line, the median separated by the radius and from the lateral by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, very close together, but separated from the lateral by the radius.

The epigynum has on the anterior margin a recurved, rounded, black-edged notch, back of which there is an inverted T-shaped middle lobe; the transverse arms are bounded at the ends by curved ridges strongly convergent anteriorly.

Holotype male, allotype female. Olcott, N. Y.

New York: Olcott, February, 1925, 1 ♂, 1 ♀ (Dietrich); Ithaca, March 21, 1925, 1 ♂ (Babiy); November 1, 1925, 3 ♂, 3 ♀; November 6, 1925, 5 ♂, 12 ♀.

Zornella Jackson.

Proc. Zool. Soc. London, 1932, p. 106.

Type: *Z. mathiseni* Jackson.

The head is rather low and the cephalic pits in the normal position. The embolic division has the tail-piece broad and rather flat; the embolus long and slender, looped, but not coiled. The base of paracymbium bears a row of two or three extremely long, highly specialized hairs.

Zornella cultrigera L. Koch.

(Plate IX, Figs. 211–215.)

Linyphia cultrigera L. Koch. Kongl. Svenska Vet. Akad. Handl. 16 (5): 11, Pl. 1, Fig. 2. 1879.
Tmeticus armatus Banks. Ent. Soc. Wash. Proc. 7: 98, Pl. 2, Fig. 12. 1905.
Lophocarenum armatum Emerton. Conn. Acad. Sci. Trans. 16: 393, Pl. 2, Fig. 8. 1911.
Gongylidium armatus Emerton. Roy. Can. Inst. Trans. 12: 315. 1919.
Diplocephalus cryptodon Chamberlin. Can. Ent. 52: 196, Fig. 21. 1920.
Tmeticus cultigerus Crosby & Bishop. Cornell Univ. Agr. Exp. Sta. Mem. 101: 1052. 1928.
Zornella mathiseni Jackson. Zool. Soc. London, Proc. 1932, p. 107, Pl. 1, Figs. 1–4.

Male.—Length, 3.5 mm. Cephalothorax reddish orange, lighter on the cephalic lobe, broad, evenly rounded on the sides with a very slight constriction at the cervical groove, broadly rounded across the front; viewed from the side, low, very gradually ascending to the cervical groove where there is a broad, shallow depression and then gently rounded over the cephalic lobe to the posterior eyes. The cephalic pit immediately back of the posterior lateral eye in the anterior end of shallow groove. Clypeus concave below the eyes, then convex, slightly protruding.

Posterior eyes in a slightly procurved line, equal, the median separated by the diameter and from the lateral by three times the radius. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by a little less than the radius and from the lateral by about twice the diameter.

Sternum and labium orange-yellow, lightly suffused with dusky, darker towards the margin; endites strongly thickened, orange-yellow, sparsely clothed with strong, dark hairs. Chelicerae robust, divaricate, narrowed towards the tip, the claw long and stout. Each chelicera armed on the face in front, one-third the distance from the base, with a large, pointed tooth directed forward and downward, tipped with a minute hair. Inner face of the chelicera armed above the furrow with a large tooth bearing two hairs. Lower and upper margins of the furrow of the chelicera armed with four evenly spaced teeth, decreasing in size towards the base of the claw. Legs orange-yellow, paler than cephalothorax; trochanter of first and second legs provided below with a rounded protuberance armed with a cluster of stiff hairs. Abdomen gray.

Trochanter of palpus armed below with a protuberance larger than on legs. Femur long, gradually thickened distally, curved inward and downward. Patella widened distally, armed ventrally at tip with a stout, pointed process somewhat as in Erigone, the mesal angle widened and protuberant. Tibia short, strongly widened distally, the dorsal margin nearly straight across the middle with a short, thin mesal process and a longer dorsolateral apophysis, which is nearly straight on the mesal side and rounded laterally. Paracymbium strongly curved under the base of the bulb, the flattened apical part gourd-shaped. From the extreme base of the paracymbium there arises three very long, stout, closely appressed hairs distinctly dentate apically.

Tail-piece of the embolic division thin and twisted but not spirally curved, reaching the edge of the tegulum. The embolus long and slender, looped across the tip of the bulb and then looped back on the mesal side of the bulb and across behind the bezel.

Female.—Length, 3.4 mm. Similar to the male in form and color. Posterior eyes in a very slightly procurved line, equal, the median separated by the diameter and a little closer to the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by one-third the diameter and from the lateral by two-thirds the diameter. The epigynum has a median lobe broad at base, narrow at the middle and strongly incurved posteriorly; on each side of the middle lobe there is a large crescent-shaped opening.

Type localities: Chantajskoj (lat. 68° 5′); Nischnij Jubatsk (lat. 63° 50′) and Surgutskoj (lat. 62° 50′), Jenissej River, Siberia.

Maine: Presque Isle, August 26, 1925, 1 ♂. *New York:* Mt. Whiteface, August 22, 1916, 7 ♂, 6 ♀; August 25, 1921, 1 ♂; September 13, 1931, 1 ♂ (Hammer); Hague, September 18, 1925, 1 ♂ (Leonard).

Emerton has recorded the species from Crawford Notch, N. H.; Montana; Sulfur Mt., Banff, Alta.; Laggan, B. C.; Vancouver Id.; Seward, Alaska. Chamberlin recorded it from Utah and St. Paul's Id., Alaska. Adams recorded it from Mt. Marcy, N. Y.

We sent a specimen of the species collected at Hague, N. Y., to Dr. R. Jackson and he compared it with the type of *mathiseni*, from Lapland. He pronounced them identical. He does not, however, agree with us in considering it the same as *cultigera* L. Koch, because Koch's figure and description indicate only two specialized hairs on the base of the paracymbium. These hairs are likely to stick together so that one can be easily overlooked, or one may have been broken off.

Chocorua new genus.

Type: *Lophocarenum cuneatum* Emerton.

The head of the male is moderately elevated and the cephalic pits are in the normal position. The embolic division is rather simple and lies bent over the greatly developed median apophysis which ends in two points. The tibia is armed with a very long process of peculiar form, see Figures 216–222, Plate IX.

Chocorua cuneata Emerton.

(Plate IX, Figs. 216–222.)

Lophocarenum cuneatum Emerton. Conn. Acad. Sci. Trans. 14: 188, Pl. 3, Fig. 6. 1909.

Male.—Length, 1.4 mm. Cephalothorax gray over dull yellow with darker radiating lines; viewed from above rather broad, the sides convergent towards the front, obtusely pointed in front; the cephalic lobe with the sides nearly parallel, slightly convergent behind, marked with a double median dark line. Cephalothorax viewed from the side rather steeply ascending behind and then nearly level to the base of the cephalic lobe. The latter high, rounded over the back to the posterior median eyes and then curved steeply downward to the anterior median. Clypeus straight, slanting forward. Cephalic pit small, round, situated in a deep furrow.

Posterior eyes in a procurved line, the median separated by twice the diameter and from the lateral by a little greater distance. Anterior eyes in a gently procurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by a little more than the diameter. Sternum short and broad, convex, smooth and shining, dark gray, almost black over dull yellow. Labium same color as sternum. Endites dull yellow suffused with gray. Legs and palpi straw yellow. Abdomen gray, nearly black.

Femur of palpus gently curved inward and downward, slightly thickened distally. Patella short, curved downward. Ratio of length of femur to that of patella as 17 to 7. Tibia longer than patella, greatly widened distally, dorsally produced into a very long process. Just beyond the middle the outer half ends squarely but the inner half is continued, curving outward and backward and ends in a rounded, finely serrate, widened tip. Paracymbium broad at base with a deep, rounded notch just before the tip. Tegulum narrow with the bezel high and rounded. Embolic division consists of a broad, flat, rounded tail-piece which reaches the edge of the tegulum. The embolus arises directly from the tail-piece; it is a thin, flat process, widened in the middle and ends in a sharp point; it curves around the tip of the median apophysis. The latter is extraordinarily developed into a long process which projects through the curve of the embolus and ends in a black, curved point with a smaller black tooth on the lateral side on a level with the embolus.

Female.—Length, 2.7 mm. Similar to the male in color. Posterior eyes in a very slightly procurved line, equal, the median separated by three times the radius and a little nearer the lateral. Anterior eyes in a slightly procurved line, the median not much smaller than the lateral, separated by about the radius and a little farther from the lateral. The epigynum consists of two narrowly separated lobes produced posteriorly into narrow, bluntly rounded, convergent points.

Type locality: Fitzwilliam, N. H.

New Hampshire: Fitzwilliam, May 25, 1907, ♂ (Emerton), May 24, 1906, ♂ (Bryant); L. Winnepesaukee, May 25, 1906, ♂ (Bryant); Chocorua, June 1, 1912, ♂ (Bryant). *New York:* Crusoe Lake, Wayne Co., May 17, 1920, 1 ♂; Sylvan Beach, July, 1904, 1 ♀; Snyders Lake, Rensselaer Co., June 15, 1930, 1 ♂, 4 ♀. *Ontario:* Sanford, June, 1906, 1 ♂. *Quebec:* Lake Megantic, July, 1916, ♂ (Emerton).

Phlattothrata new genus.

Type: *Lophocarenum flagellatum* Emerton.

In this genus the embolic division is simple, nearly straight, with the embolus short and wide at tip. The head of the male is high and the cephalic pits are placed very high, above the level of the posterior median eyes.

Phlattothrata flagellata Emerton.

(Plate IX, Figs. 223-227.)

Lophocarenum flagellatum Emerton. Conn. Acad. Sci. Trans. 14: 393, Pl. 2, Fig. 6. 1911.

Male.—Length, 1.3 mm. Cephalothorax brownish yellow suffused with dusky and with dark radiating lines and margin; viewed from above evenly and broadly rounded on the sides to the cervical groove where there is a slight constriction, the sides then slightly converging, evenly and broadly rounded across the front. The cephalic lobe with the sides constricted opposite the pits, evenly rounded behind, broadly rounded across the front. Cephalothorax viewed from the side, steeply ascending behind to the top of the lobe with only a slight depression at the cervical groove; cephalic lobe gently rounded over the top, the front face slanting forward; clypeus slightly convex and protruding. Cephalic pit small, round, high on the side of the lobe and overhung by a short ridge, high above and back of the lateral eyes.

Posterior eyes in a recurved line, the median a little larger than the lateral, separated by their diameter, a little farther from the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by about the radius and from the lateral by the diameter.

Sternum dull yellow, strongly suffused with dusky, darker at the margin, broad, strongly convex, smooth and shining; labium dark, lighter distally; endites grayish, darker on the outer angle, lighter at tip. Legs and palpi orange-yellow, the coxae below with a dark band distally. Abdomen dark greenish gray with a suggestion of a herring-bone pattern on the posterior half.

Femur of the palpus short, somewhat widened distally, slightly curved inward. Patella moderately long, thick, widened distally; ratio of length of femur to that of patella as 9 to 5; tibia short, at its base narrower than patella, abruptly widened near the middle of its length. The dorsolateral apophysis broad at base, abruptly narrowing to form a long, slender process which curves over the back of the cymbium. On the lateral side near the base of the apophysis a very long, slender, curved spine. Paracymbium broad at base, flat, tapering, and curved in a flat spiral of nearly a complete turn. Tegulum wide, protuberant ventrally, the bezel high and produced to a blunt point opposite the embolus. Tail-piece of the embolic division a broad, thin, flat plate, its free end rounded and lying near the edge of the cymbium. The embolus arises directly from the tail-piece as a short, stout, black rod somewhat twisted at the tip and with a sharp, black tooth on the dorsal side near the tip.

Described from the type, a single male in the collection of the Museum of Comparative Zoology at Cambridge, Mass.

Type locality: Seal Harbor, Mt. Desert, Me., July 1, 1909. Emerton, collector.

Cochlembolus Crosby.

Ent. News 40: 79. 1929.

Type: *Dismodiscus* [sic] *alpinus* Banks.

Related to Spirembolus, Tortembolus and Scotinotytus by the spiral form of the embolic division. The head of the male is elevated with a distinct lobe and cephalic pits are present. Cochlembolus differs from Spirembolus and Scotinotylus by the cephalic pits in the male and from Tortembolus by the shorter apophysis on the tibia of the male palpus.

The following species have been described and figured by Crosby in Ent. News 40: 79–83, 1929: *C. alpinus* Banks, *C. sanctus* Crosby, *C. sacer* Crosby, *C. vernalis* Emerton.

Cochlembolus sacerdotalis n. sp.

(Plate IX, Figs. 228–231.)

Male.—Length, 1.9 mm. Cephalothorax yellowish brown, narrowly darker at margin, cephalic lobe lighter, grayish, viewed from above evenly rounded on the sides without any constriction at the cervical groove, broadly rounded across the front. Cephalic lobe viewed from above with the sides slightly convex, broadly rounded behind and nearly straight across the front. Cephalothorax viewed from the side steeply ascending behind in a nearly straight line to the base of the cephalic lobe, evenly and broadly rounded over the lobe to posterior median eyes. Median ocular area gently convex, slanting forward. Clypeus strongly convex and protruding. Cephalic pit small, in a narrow groove, just back of and above the posterior lateral eye.

Posterior eyes in a slightly recurved line, equidistant, separated by the diameter, the median slightly smaller than the lateral. Posterior median eyes borne in front of the cephalic lobe. Anterior eyes in a straight line, the median smaller than the lateral, separated by less than the radius and from the lateral by the diameter.

Sternum strongly mottled with dusky patches over dull yellow (possibly abnormal), broad, convex. Labium dark. Endites yellow suffused with dusky, lighter distally. Legs dusky orange-yellow. Coxae and trochanters dark distally below. Abdomen dark gray.

Femur of palpus strongly curved inward, widened distally. Patella long, slightly swollen, widened distally. Ratio of length of femur to patella as 17 to 12. Tibia at base narrower than patella, constricted, then greatly widened, dorsally produced into a rather long, straight, blunt, apophysis; tibia armed at base dorsolaterally with a long, stiff, black spine. Cymbium narrow, bluntly angulate at base, widened distally. Paracymbium very long, slender, strongly incurved at tip. Tegulum protuberant ventrally. Tail-piece of the embolic division long, slender and twisted; embolus a long style, coiled in an open spiral of two complete turns. Median apophysis appears between the embolus and the bezel as a rather long, sharp, black process.

Holotype, male. Karner, Albany Co., N. Y., March 24, 1923. Collected by sifting leaf-mold.

Cochlembolus pallidus Emerton.

(Plate X, Figs. 232–237.)

Lophocarenum pallidum Emerton. Conn. Acad. Sci. Trans. 6: 48, Pl. 13, Fig. 5. 1882.
Erigone pallens Marx. U. S. Nat. Mus. Proc. 12: 535. 1890.
Typhocraestus pallidus Simon. Ar. Fr. 5: 589. 1884.
Typhocraestus pallidus Simon. Hist. Nat. Ar. 1: 629. 1894.
Typhocraestus pallidus Crosby. Phila. Acad. Nat. Sci. Proc., p. 309. 1905.
Lophocarenum pallidum Emerton. Conn. Acad. Sci. Trans. 14, Pl. 3, Fig. 7. 1909.

Male.—Length, 1.1–1.3 mm. Cephalothorax brownish yellow with the front part of the cephalic lobe and an area back of it paler, viewed from above rounded on the sides, narrowed towards the front, rounded across the front, with a slight constriction at the cervical groove; the cephalic lobe with the sides nearly straight, narrower behind than in front. Cephalothorax viewed from the side ascending steeply in a straight line to just back of the cervical groove where it is nearly level. Cephalic lobe high, rounded over the back and top but in front descending steeply in line with the clypeus; clothed in front with a group of hairs directed downward. Posterior median eyes borne on the front face of the cephalic lobe. Cephalic pits distinct and situated in deep grooves just back of and a little above the posterior lateral eyes. Clypeus strongly convex, projecting forward.

Posterior eyes in a recurved line, equidistant, separated by the diameter of the median. Anterior eyes in a straight line, the median smaller than the lateral, almost touching but separated from the lateral by two-thirds the diameter.

Chelicerae brownish yellow. Sternum broad, convex, smooth and shining, grayish over yellow orange, darker at the margin. Endites orange yellow. Hind coxae separated by the diameter. Legs and palpi yellow orange. Abdomen gray. Epigastric plates coarsely striate.

Femur of palpus nearly straight, compressed, widened distally, curved inward. Patella nearly straight, stout, thicker distally. Ratio of length of femur to that of patella as 13 to 9. Tibia short, the dorsal margin rounded mesally, armed dorsally with a sharp, black, incurved point which lies just outside the prolonged base of cymbium. Cymbium prolonged at base into a distinct point. Just in front of this point is a distinct tooth. Paracymbium long, slender and curved in a semicircle. Bezel high and quadrate. The embolic division has the tail-piece very long, flattened and coiled spirally as in the other species; the apical part long, slender, whip-like and coiled in a flat spiral of a little more than two turns on the inner side of tip of the palpus.

Female.—Length, 1.1–1.3 mm. Posterior eyes in a gently recurved line, the median separated by a little less than the diameter and slightly farther from the lateral. Anterior eyes in a gently recurved line, the median smaller than the lateral, very close together on a black spot, but separated from the lateral by the diameter.

The epigynum consists of a very broad middle lobe, the transverse part with the ends broadly rounded, the septum provided with longitudinal ridge which has a finger-like appearance. The front margin of epigynum armed with a median black, rounded tooth.

Type locality: White Mts., N. H., June, 1878.

New Hampshire: North Woodstock, September, 1911, ♂. *New York:* Auger Pond, November 17, 1916, 4 ♂, 7 ♀; Jabes Pond, Lake George, September 11, 1925, 1 ♂ (Leonard); Wells, April 27, 1923, 4 ♂, 12 ♀; Karner, March 24, 1923, 2 ♂, 1 ♀; Albany, April 9, 1931, 2 ♂, 9 ♀; Voorheesville, May 12, 1923, 1 ♂; Lake Pleasant, April 27, 1923, 7 ♂, 10 ♀. *Massachusetts:* Lexington, November 5, 1922, 1 ♂, 4 ♀; Magnolia, April 19, 1906, ♂ (Bryant).

EXPLANATION OF PLATES.

Plate I.

Figs. 1–5. *Ceratinops annulipes:* 1, ♂ cephalothorax, dorsal view; 2, ♂ cephalothorax, lateral view; 3, ♂ right palpus, tibia, dorsal view; 4, ♂ right palpus, mesoventral view; 5, ♀ epigynum.

Figs. 6–9. *Ceratinops carolina:* 6, ♂ cephalothorax, dorsal view; 7, ♂ cephalothorax, lateral view; 8, ♂ right palpus, tibia, dorsal view; 9, ♂ right palpus, mesal view.

Figs. 10–16. *Ceratinops crenata:* 10, ♂ cephalothorax, dorsal view; 11, ♂ cephalothorax, lateral view; 12, ♂ right palpus, tibia, dorsal view; 13, ♂ right palpus, mesoventral view; 14, ♂ right palpus, lateral view; 15, ♂ right palpus, mesal view; 16, ♀ epigynum.

Figs. 17–21. *Ceratinops inflata:* 17, ♂ cephalothorax, dorsal view; 18, ♂ cephalothorax, lateral view; 19, ♂ right palpus, tibia, dorsal view; 20, ♂ right palpus, mesoventral view; 21, ♀ epigynum.

Figs. 22–28. *Ceratinops lata:* 22, ♂ cephalothorax, dorsal view; 23, ♂ cephalothorax, lateral view; 24, ♂ right palpus, tibia, dorsal view; 25, ♂ right palpus, ventral view; 26, ♂ right palpus, mesoventral view; 27, ♂ right palpus, lateral view; 28, ♀ epigynum.

Plate II.

Figs. 29–34. *Ceratinops littoralis:* 29, ♂ cephalothorax, dorsal view; 30, ♂ cephalothorax, lateral view; 31, ♂ right palpus, tibia, dorsal view; 32, ♂ right palpus, lateral view; 33, ♂ right palpus, mesoventral view; 34, ♀ epigynum.

Figs. 35–39. *Ceratinops rugosa:* 35, ♂ cephalothorax, dorsal view; 36, ♂ cephalothorax, lateral view; 37, ♂ right palpus, tibia, dorsal view; 38, ♂ right palpus, mesoventral view; 39, ♀ epigynum.

Figs. 40–44. *Tapinocyba dietrichi:* 40, ♂ cephalothorax, dorsal view; 41, ♂ cephalothorax, lateral view; 42, ♂ right palpus, tibia, dorsolateral view; 43, ♂ right palpus, mesoventral view; 44, ♀ epigynum.

Figs. 45–48. *Tapinocyba hortensis:* 45, ♂ cephalothorax, dorsal view; 46, ♂ cephalothorax, lateral view; 47, ♂ right palpus, tibia, dorsal view; 48, ♂ right palpus, mesoventral view.

Figs. 49–53. *Tapinocyba minuta:* 49, ♂ cephalothorax, dorsal view; 50, ♂ cephalothorax, lateral view; 51, ♂ right palpus, tibia, dorsal view; 52, ♂ right palpus, mesal view; 53, ♀ epigynum.

PLATE III.

Figs. 54–58. *Tapinocyba scopulifera:* 54, ♂ cephalothorax, dorsal view; 55, ♂ cephalothorax, lateral view; 56, ♂ right palpus, tibia, dorsal view; 57, ♂ right palpus, mesoventral view; 58, ♀ epigynum.

Figs. 59–63. *Tapinocyba simplex:* 59, ♂ cephalothorax, dorsal view; 60, ♂ cephalothorax, lateral view; 61, ♂ right palpus, tibia, dorsal view; 62, ♂ right palpus, mesal view; 63, ♀ epigynum.

Figs. 64–68. *Lophomma depressum:* 64, ♂ cephalothorax, dorsal view; 65, ♂ cephalothorax, lateral view; 66, ♂ right palpus, tibia, dorsal view; 67, ♂ right palpus, mesoventral view; 68, ♂ embolic division.

Figs. 69–73. *Lophomma pingrensis:* 69, ♂ cephalothorax, dorsal view; 70, ♂ cephalothorax, lateral view; 71, ♂ right palpus, tibia, dorsolateral view; 72, ♂ right palpus, mesoventral view; 73, ♀ epigynum.

Figs. 74–77. *Lophomma sylvaticum:* 74, ♂ cephalothorax, dorsal view; 75, ♂ cephalothorax, lateral view; 76, ♂ right palpus, tibia, dorsolateral view; 77, ♂ right palpus, mesoventral view.

PLATE IV.

Figs. 78–81. *Lophomma umbilicatum:* 78, ♂ cephalothorax, dorsal view; 79, ♂ cephalothorax, lateral view; 80, ♂ right palpus, tibia, dorsal view; 81, ♂ right palpus, ventral view.

Figs. 82–87. *Lophomma vaccinii:* 82, ♂ cephalothorax, dorsal view; 83, ♂ cephalothorax, lateral view; 84, ♂ right palpus, tibia, dorsal view; 85, ♂ right palpus, mesoventral view; 86, ♂ embolic division; 87, ♀ epigynum.

Figs. 88–92. *Hypomma marxii:* 88, ♂ cephalothorax, dorsal view; 89, ♂ cephalothorax, lateral view; 90, ♂ right palpus, tibia, dorsal view; 91, ♂ right palpus, mesal view; 92, ♀ epigynum.

Figs. 93–98. *Aulacocyba subitanea:* 93, ♂ cephalothorax, dorsal view; 94, ♂ cephalothorax, lateral view; 95, ♂ right palpus, tibia, dorsal view; 96, ♂ right palpus, mesoventral view; 97, ♂ right palpus, mesal view; 98, ♀ epigynum.

Figs. 99–103. *Hypselistes florens:* 99, ♂ cephalothorax, dorsal view; 100, ♂ cephalothorax, lateral view; 101, ♂ right palpus, lateral view; 102, ♂ right palpus, ventral view; 103, ♀ epigynum.

PLATE V.

Figs. 104–109. *Minyriolus aquatilis:* 104, ♂ cephalothorax, dorsal view; 105, ♂ cephalothorax, lateral view; 106, ♂ right palpus, tibia, dorsal view; 107, ♂ right palpus, lateral view; 108, ♂ right palpus, ventral view; 109, ♀ epigynum.

Figs. 110–115. *Minyriolus arenarius:* 110, ♂ cephalothorax, dorsal view; 111, ♂ cephalothorax, lateral view; 112, ♂ right palpus, dorsal view; 113, ♂ right palpus, mesal view; 114, ♂ right palpus, lateral view; 115, ♀ epigynum.

Figs. 116–121. *Minyriolus castaneus:* 116, ♂ cephalothorax, dorsal view; 117, ♂ cephalothorax, lateral view; 118, ♂ right palpus, tibia, dorsal view; 119, ♂ right palpus, mesal view; 120, ♂ right palpus, lateral view; 121, ♀ epigynum.

Figs. 122–126. *Pocadicnemis hartlandiana:* 122, ♂ cephalothorax, dorsal view; 123, ♂ cephalothorax, lateral view; 124, ♂ right palpus, tibia, mesodorsal view; 125, ♂ right palpus, view of end of bulb; 126, ♂ right palpus, lateral view.

Figs. 127–131. *Pocadicnemis pumila:* 127, ♂ cephalothorax, dorsal view; 128, ♂ cephalothorax, lateral view; 129, ♂ right palpus, dorsal view; 130, ♂ right palpus, mesal view; 131, ♀ epigynum.

PLATE VI.

Figs. 132–135. *Mythoplastoides abruptus:* 132, ♂ cephalothorax, dorsal view; 133, ♂ cephalothorax, lateral view; 134, ♂ right palpus, lateral view; 135, ♂ right palpus, mesal view.

Figs. 136–141. *Mythoplastoides erectus:* 136, ♂ cephalothorax, dorsal view; 137, ♂ cephalothorax, lateral view; 138, ♂ right palpus, tibia, dorsal view; 139, ♂ right palpus, ventral view; 140, ♂ right palpus, mesal view; 141, ♀ epigynum.

Figs. 142–149. *Mythoplastoides exiguus:* 142, ♂ cephalothorax, dorsal view; 143, ♂ cephalothorax, lateral view; 144, ♂ right palpus, tibia, dorsal view; 145, ♂ right palpus, lateral view; 146, ♂ right palpus, mesodorsal view; 147, ♂ right palpus, mesal view; 148, ♂ left palpus, tibia; 149, ♀ epigynum.

Figs. 150–158. *Eridantes erigonoides:* 150, ♂ cephalothorax, dorsal view; 151, ♂ cephalothorax, lateral view; 152, ♂ right palpus, tibia, dorsal view; 153, ♂ right palpus, dorsolateral view; 154, ♂ right palpus, lateral view; 155, ♂ right palpus, mesal view; 156, ♂ right palpus, ventral view; 157, ♂ right palpus, mesoventral view; 158, ♀ epigynum.

PLATE VII.

Figs. 159–164. *Eridantes utibilis:* 159, ♂ cephalothorax, dorsal view; 160, ♂ cephalothorax, lateral view; 161, ♂ right palpus, dorsal view; 162, ♂ right palpus, dorsolateral view; 163, ♂ right palpus, lateral view; 164, ♂ right palpus, mesoventral view.

Figs. 165–169. *Dismodicus decemoculatus:* 165, ♂ cephalothorax, dorsal view; 166, ♂ cephalothorax, lateral view; 167, ♂ right palpus, dorsal view; 168, ♂ right palpus, mesal view; 169, ♀ epigynum.

Figs. 170–176. *Horcotes quadricristatus:* 170, ♂ cephalothorax, dorsal view; 171, ♂ cephalothorax, lateral view; 172, ♂ right palpus, tibia, dorsal view; 173, ♂ right palpus, lateral view; 174, ♂ right palpus, mesal view; 175, ♂ right palpus, mesal view; 176, ♀ epigynum.

Figs. 177–180. *Baryphyma longitarsum:* 177, ♂ cephalothorax, dorsal view; 178, ♂ cephalothorax, lateral view; 179, ♂ right palpus, dorsal view; 180, ♂ right palpus, mesoventral view.

Figs. 181–185. *Origanates rostratus:* 181, ♂ cephalothorax, dorsal view; 182, ♂ cephalothorax, lateral view; 183, ♂ right palpus, tibia, dorsal view; 184, ♂ right palpus, mesoventral view; 185, ♀ epigynum.

PLATE VIII.

Figs. 186–193. *Hybocoptus dentipalpis:* 186, ♂ cephalothorax, dorsal view; 187, ♂ cephalothorax, lateral view; 188, ♂ right palpus, tibia, dorsal view; 189, ♂ right palpus, ventral view; 190, ♂ right palpus, mesal view; 191, ♂ front view of head; 192, ♂ right palpus, mesolateral view; 193, ♀ epigynum.

Figs. 194–198. *Symmigma minimum:* 194, ♂ cephalothorax, dorsal view; 195, ♂ cephalothorax, lateral view; 196, ♂ right palpus, dorsal view; 197, ♂ right palpus, lateral view; 198, ♂ right palpus, mesoventral view.

Figs. 199–204. *Dietrichia hesperia:* 199, ♂ cephalothorax, dorsal view; 200, ♂ cephalothorax, lateral view; 201, ♂ left palpus, tibia, dorsal view; 202, ♂ left palpus, mesoventral view; 203, ♂ tip of tibial apophysis; 204, ♀ epigynum.

Figs. 205–210. *Hormathion limnatum:* 205, ♂ cephalothorax, dorsal view; 206, ♂ cephalothorax, lateral view; 207, ♂ right palpus, tibia, dorsal view; 208, ♂ right palpus, dorsolateral view; 209, ♂ right palpus, mesoventral view; 210, ♀ epigynum.

PLATE IX.

Figs. 211–215. *Zornella cultrigera:* 211, ♂ cephalothorax, dorsal view; 212, ♂ cephalothorax, lateral view; 213, ♂ right palpus, tibia, dorsal view; 214, ♂ right palpus, mesoventral view; 215, ♀ epigynum.

Figs. 216–222. *Chocorua cuneata:* 216, ♂ cephalothorax, dorsal view; 217, ♂ cephalothorax, lateral view; 218, ♂ right palpus, tibia, dorsal view; 219, ♂ right palpus, dorsomesal view; 220, ♂ right palpus, mesal view; 221, ♂ right palpus, lateral view; 222, ♀ epigynum.

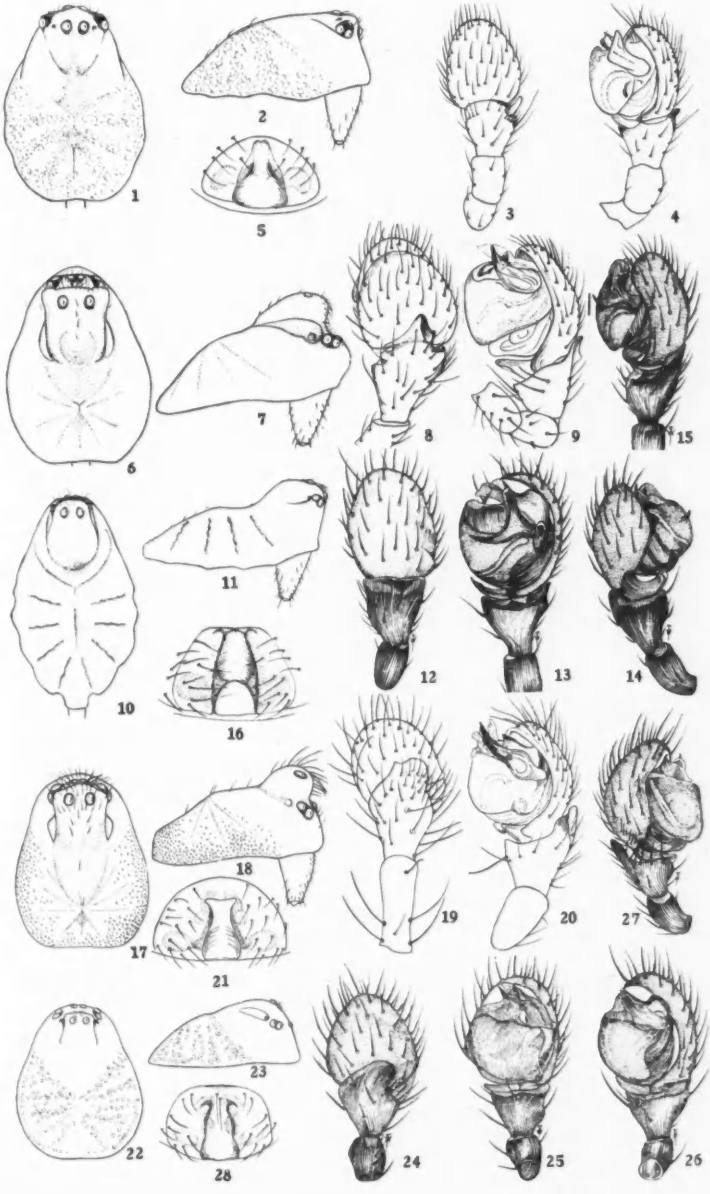
Figs. 223–227. *Phlattothrata flagellata:* 223, ♂ cephalothorax, dorsal view; 224, ♂ cephalothorax, lateral view; 225, ♂ right palpus, tibia, dorsolateral view; 226, ♂ right palpus, mesoventral view; 227, ♂ right palpus, mesoventral view.

Figs. 228–231. *Cochlembolus sacerdotalis:* 228, ♂ cephalothorax, dorsal view; 229, ♂ cephalothorax, lateral view; 230, ♂ right palpus, tibia, dorsal view; 231, ♂ right palpus, mesal view.

PLATE X.

Figs. 232–237. *Cochlembolus pallidus:* 232, ♂ cephalothorax, dorsal view; 233, ♂ cephalothorax, lateral view; 234, ♂ right palpus, lateral view; 235, ♂ right palpus, dorsal view; 236, ♂ right palpus, ventral view; 237, ♀ epigynum.

The preparation of the drawings, by Albert W. Force of Ithaca, N. Y., and Helen M. Zorsch of Rochester, N. Y., was made possible by a grant from the Heckscher Research Foundation at Cornell University.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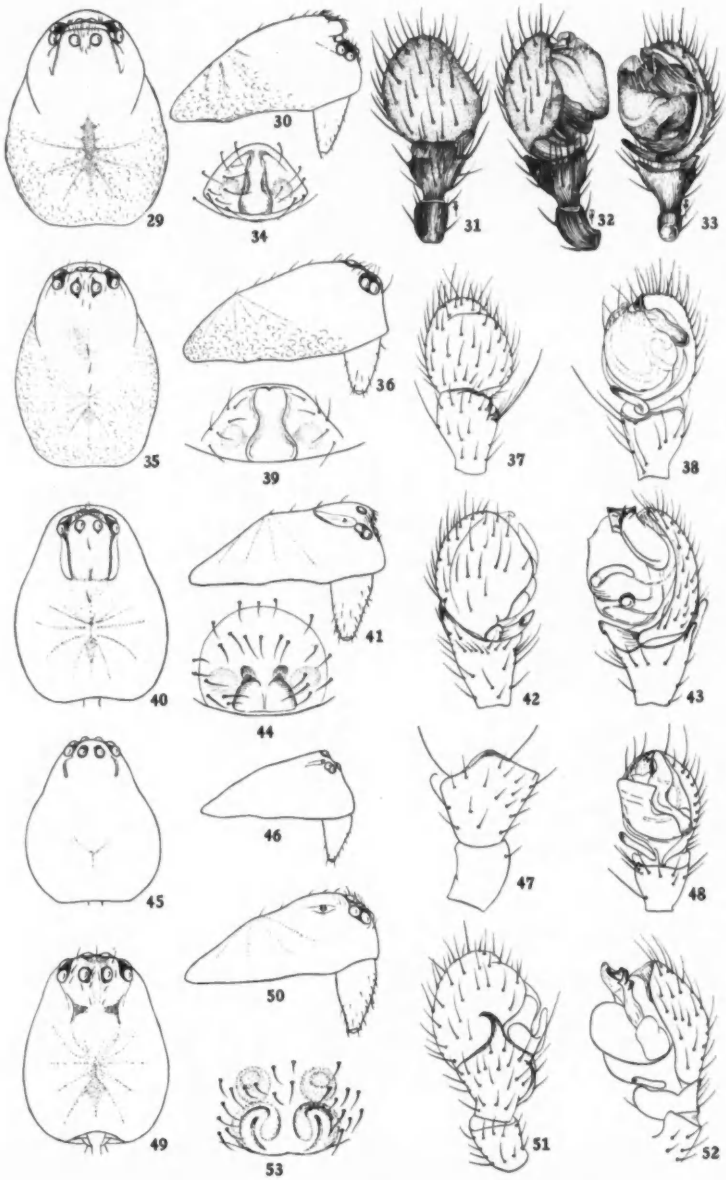
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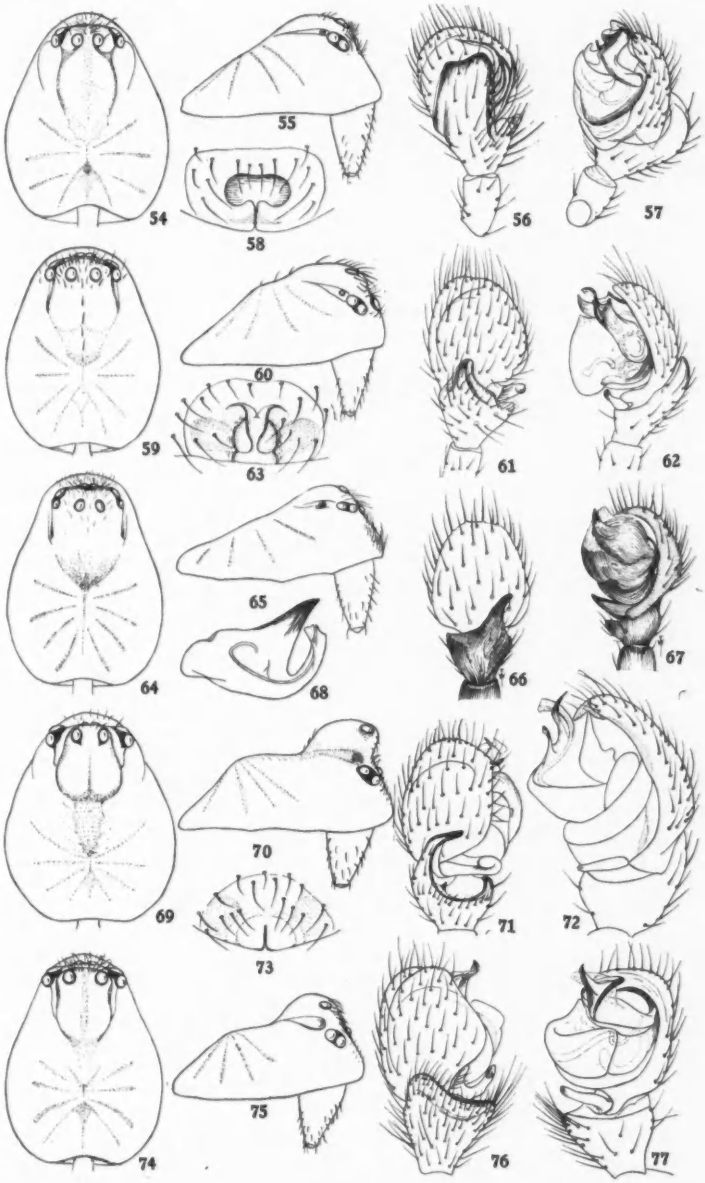
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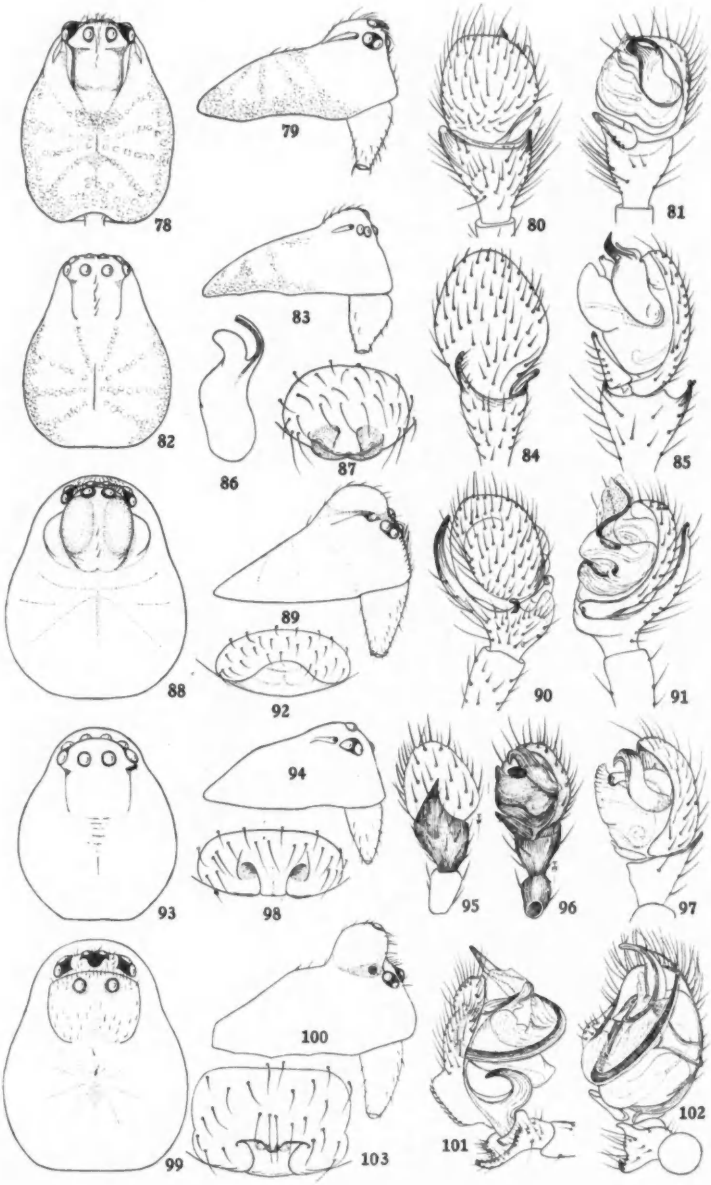
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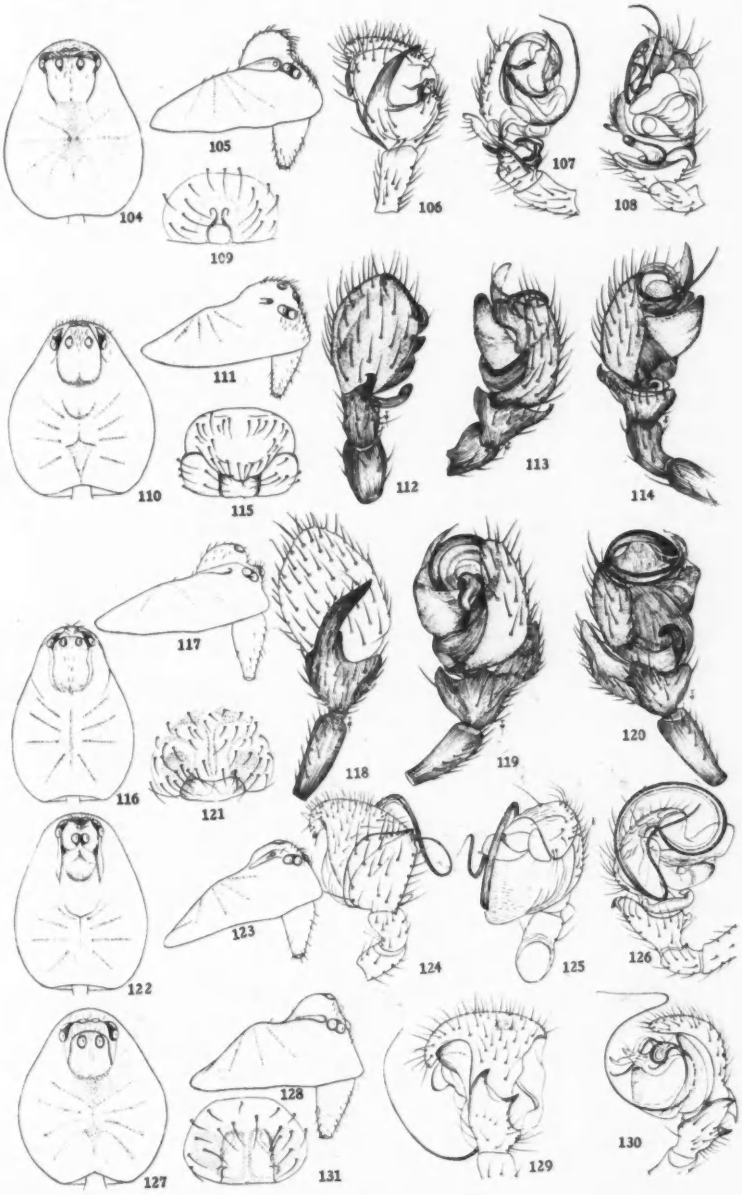
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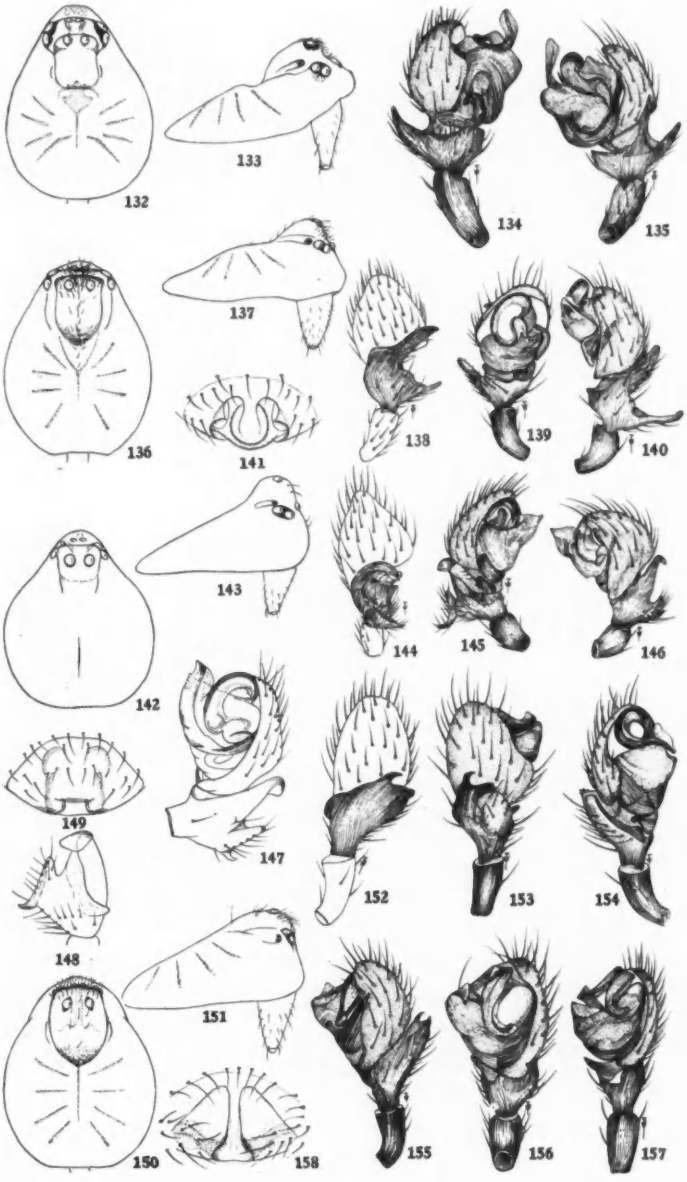
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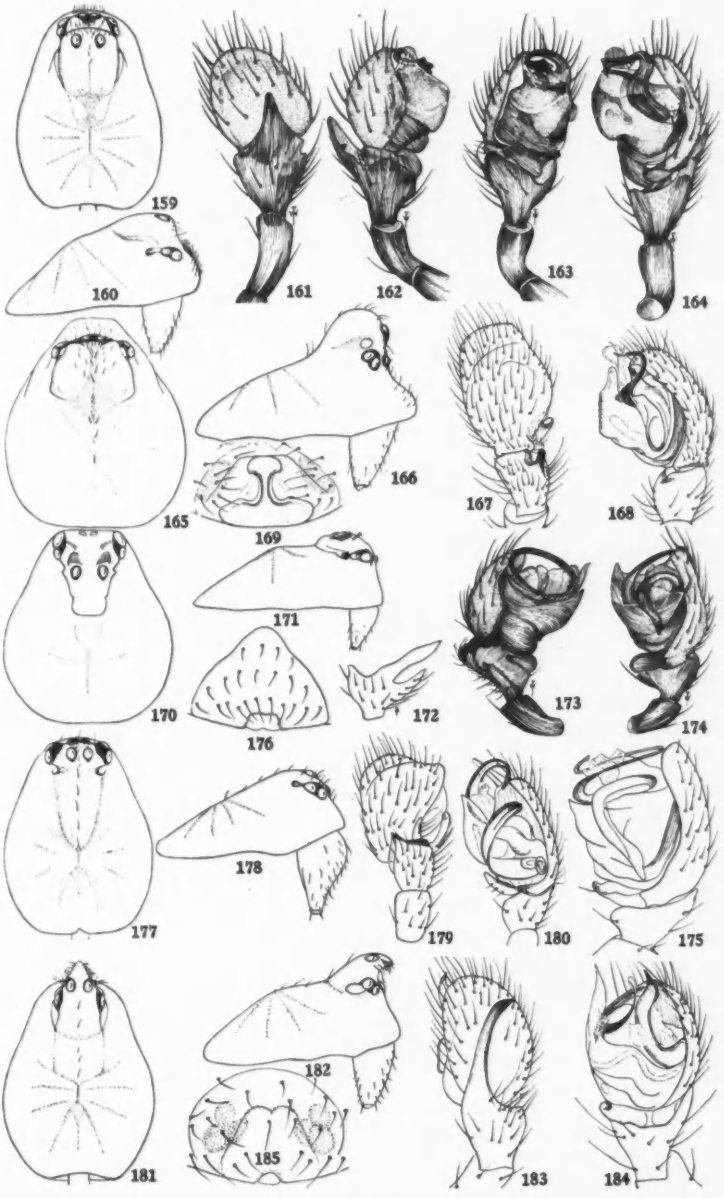
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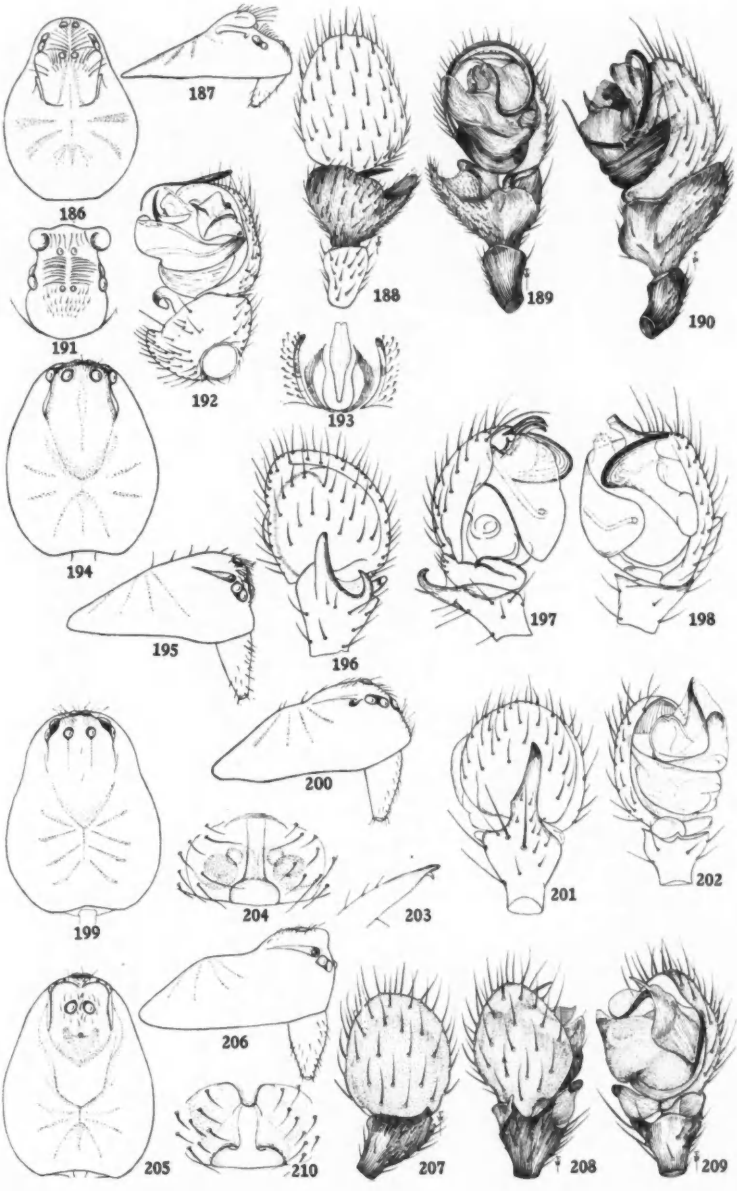
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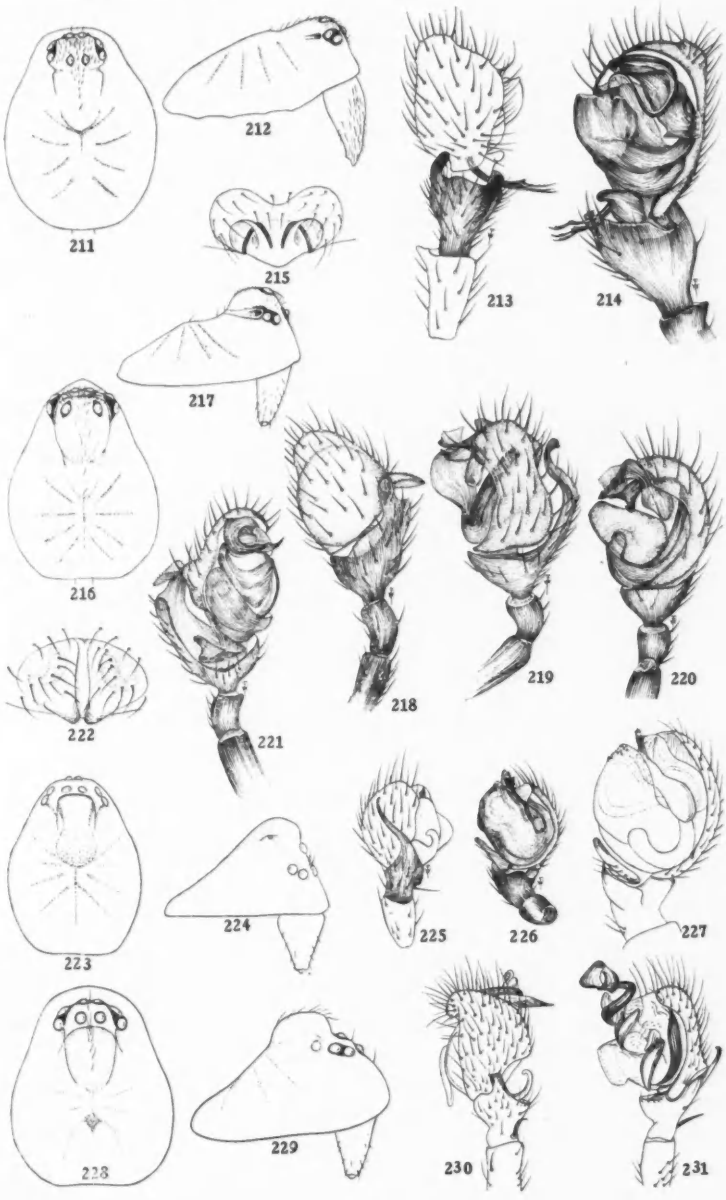
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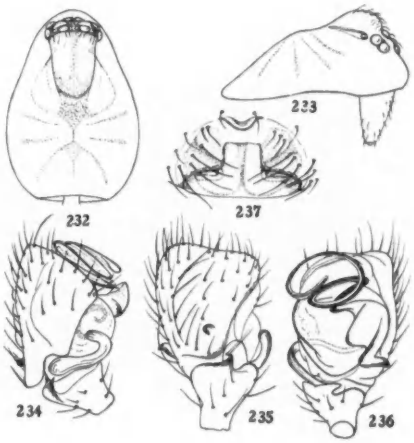
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PROCEEDINGS OF THE TWENTY-SEVENTH ANNUAL MEETING.

Atlantic City, New Jersey, December 28th and 29th, 1932.

The Entomological Society of America held its Twenty-seventh Annual Meeting on Wednesday and Thursday. Thirty-four papers dealing with research work in many phases of Entomological study were presented. Some of these dealt with quite new fields of investigation. In addition one afternoon was devoted to a symposium and an evening to the annual address. The Annual Address was given by Dr. J. M. Swaine, Associate Dominion Entomologist, Ottawa, Canada. The subject of his address was "The Influence of Insect Life on Forest Development" and was accompanied by an interesting set of slides showing mainly the Canadian forests and the destructive influences of insect activity. The following symposium was presented: "The Influence of Civilization on the Insect Fauna of North America."

(a) In American Forest Populations. S. A. GRAHAM, University of Michigan.
(b) In Regions of Industrial Activity. P. W. CLAASSEN, Cornell University.
(c) In Cultivated Areas. R. C. SMITH, Kansas State College.
(d) By Purposeful Introductions. H. S. SMITH, University of California.

In the above symposium the activities of civilized man were shown to have a mighty influence on the insect population of North America, increasing some species to destructive outbreaks in forests and fields and reducing others to a marked degree, and in each case affecting to a surprising extent other living things both plant and animal.

Opening Session, Wednesday Morning, December 28.

The Society was called to order at 10:00 A. M., by PRESIDENT J. J. DAVIS, in Benjamin West Room, Haddon Hall, Atlantic City, N. J. The following papers were presented:

1. Distribution of Radio Active Lead Arsenate in Insect Tissue and Organs. (Lantern.) DAVID E. FINK, Takoma Park, Md.
2. Bacteriological Examination of Wire Worm Larvae. (Lantern.) R. M. MELANPY, Cornell University.
3. The Division of Insects (i. e., how insects are divided). (Lantern, Blackboard.) R. E. SNODGRASS, Bureau of Entomology.
4. Phyllophaga at Light. (Lantern.) A. A. GRANOVSKY, University of Minnesota.
5. Miscellaneous Notes on the Phyllophaga of Iowa. (By Title.) BERNARD TRAVIS, Iowa State College.
6. The Psammophore of Aculeates (Hymenoptera). (Lantern.) V. S. L. PATE, Cornell University.
7. Microscopic Observations on Blood Coagulation in Several Different Species of Insects. (By Title.) J. FRANKLIN YEAGER and HARRY H. KNIGHT, Iowa State College.
8. The Fifth International Congress of Entomologists, Paris, July, 1932, (Illustrated by moving pictures). P. W. CLAASSEN, Cornell University.

The following committees were appointed by President Davis:

Nominating Committee—F. E. LUTZ, Chairman; H. E. EWING, G. M. BENTLEY.

Auditing Committee—HOWARD O. DEAY, Chairman; D. M. DELONG, P. A. READIO.

Resolutions Committee—P. J. PARROTT, Chairman; C. H. RICHARDSON, G. F. MACLEOD.

Second Session, Wednesday Afternoon, December 28.

The Society was called to order by PRESIDENT DAVIS at 1:30 P. M. the following symposium was presented: "The Influence of Civilization on the Insect Fauna of North America."

(a) In American Forest Populations. S. A. GRAHAM, University of Michigan.
(b) In Regions of Industrial Activity. P. W. CLAASSEN, Cornell University.
(c) In Cultivated Areas. R. C. SMITH, Kansas State College.
(d) By Purposeful Introductions. H. S. SMITH, University of California, Riverside.

9. Civilization and Shade Tree Insects. E. P. FELT, Bartlett Tree Research Laboratories.
10. Informal Notes on Insect Display. (Illustrations.) CHRIS E. OLSEN, American Museum Natural History, N. Y.
11. Ultraviolet Patterns in Butterflies. (Lantern.) FRANK E. LUTZ and RICHARD BURLINGAME, American Museum Natural History, New York.
12. Some Effects of Ultraviolet Light on the Bean Weevil. (Lantern.) G. F. MACLEOD, Cornell University.

PRESIDENT DAVIS appointed J. S. HOUSER, E. F. PHILLIPS, and HERBERT OSBORN to act as alternates on the Executive Committee which met immediately following the afternoon session.

Third Session, Wednesday Evening, December 28.

The Society was called to order by PRESIDENT DAVIS at 8:00 P. M. in Viking Room, Haddon Hall. The President then introduced J. M. SWAINE, who gave the Annual Public Address. DOCTOR SWAINE'S address, which was illustrated by lantern slides, was entitled "The Influence of Insect Life on Forest Development."

Fourth Session, Thursday Morning, December 29.

The Society was called to order by PRESIDENT DAVIS. The following papers were presented:

13. The Use of Sterile Blowfly Larvae in Surgery for Treatment of Infected Wounds. (Lantern.) WM. ROBINSON, U. S. Bureau of Entomology.
14. Preliminary Results of a Mosquito Survey in the Chesapeake Bay Region. F. C. BISHOPP, E. N. CORY and ALAN STONE, U. S. Bureau of Entomology.
15. Host-parasite Balance as Affected by Disease (Host: Mediterranean Flour Moth; Parasite: *Microbracon hebetor* Say). (Lantern.) NELLIE M. PAYNE, Pennsylvania University.
16. Katydid Stridulation as Affected by Temperature. (Lantern.) J. A. MANTER, Connecticut Agricultural College.
17. The Respiratory System of *Tetranychus telarius* L. (Acarina). (Lantern.) WM. E. BLAUVELT, Cornell University.

18. The Gross Morphology of the Noctuid Tympanum and Its Use in Taxonomic Studies. (Lantern.) A. GLENN RICHARDS, JR., Cornell University.
19. Determination of the Surface Area of Insects. W. A. SIMANTON; presented by CHAS. H. RICHARDSON, Iowa State College.
20. Some Notes on the Genus Rhagovelia with the Description of a New Species (Hemiptera-Veliidae). (By Title.) GEO. E. GOULD, Purdue University.
21. A Fossil Nepa from the Florissant. H. B. HUNGERFORD, University of Kansas.
22. A New Species of Diaspinae. GLENN W. HERRICK, Cornell University, and CHARLES E. FOSTER, Colgate University, Hamilton, N. Y.
23. Miscellaneous Notes and Descriptions of Chalcidoid Parasites. (By Title.) H. L. DOZIER, U. S. Bureau of Entomology.
24. The Parasites of Some Lepidopterous Stalk Borers in Iowa. GEORGE C. DECKER, Iowa State College.
25. Oriental Fruit Moth Parasite Studies with Reference to Alternate Hosts. (Lantern.) BYRLEY F. DRIGGERS and B. B. PEPPER, New Jersey Agricultural Experiment Station.
26. Observations on the Flight and Length of Life of Drone Bees. (By Title.) D. E. HOWELL and R. L. USINGER, College of Agriculture, Davis, California.
27. Insects Collected in New York Orchards in 1931. E. F. PHILLIPS, Cornell University.

Fifth Session, Thursday Afternoon, December 29.

The Society was called to order by PRESIDENT DAVIS. The following papers were presented:

28. Skin Texture of Some Agrotid Larvae. J. H. HAWKINS, Maine Agricultural Experiment Station.
29. Nearctic Social Wasps of the Subfamily Polybiinae. (By Title.) J. BEQUEART, Harvard Medical School.
30. Remarks on the Faunistic Affinities of the West Indian Homoptera. (Lantern.) HERBERT OSBORN, Ohio State University.
31. A Flying Trip among Entomologists of the West Indies. (Lantern.) J. G. NEEDHAM, Cornell University.
32. The Preparation of Bibliographies. J. CHESTER BRADLEY, Cornell University.
33. A Chapter in the History of Dipterology. J. M. ALDRICH, U. S. Bureau of Entomology.
34. The National Research Council and the Entomologist. FRANK E. LUTZ, American Museum Natural History, New York, N. Y.

The above meetings were attended by about 150.

The Annual Business Meeting followed:

REPORT OF THE SECRETARY.

Previous to August 1, 1932, the following, having been duly nominated and recommended, were elected members of the Society by mail ballot of the Executive Committee:

CHARLES A. CLARK, Drawer 359, Monroe, Michigan.
U. S. SHARGA, Etawah, U. P., India.
ARTHUR E. PRITCHARD, 410 East 16th, Oklahoma City, Okla.
SHAO-WEN LING, Department of Entomology, Cornell University, Ithaca, N.Y.
G. M. KUTCHKA, 609 Whitney Ave., Wilkinsburg, Pa.
P. N. ANNAND, Bureau of Entomology, Washington, D. C.

JOHN M. AMOS, 1711 South Street, Lafayette, Indiana.
MAURICE T. JAMES, 945 Twenty-second St., Boulder, Colorado.
BILL H. WILFORD, University of Michigan, Ann Arbor, Mich.
GONZALO MERINO, Ohio State University, Columbus, Ohio.
BERNARD SEGAL, 7 Sumner Park, Rochester, New York.
E. S. THOMAS, Ohio State Museum, Columbus, Ohio.
REV. E. H. GIBSON, Trinity Episcopal Church, Galveston, Texas, has been reinstated.

With the approval of the Executive Committee, J. M. SWAINE was invited to give the Annual Public Address of the Society at the Atlantic City meeting.

DR. T. J. HEADLEE kindly consented to act as chairman of the Arrangements Committee for the Atlantic City meeting. The other member of the committee was C. H. HADLEY.

The following men were appointed delegates of the Society to the International Entomological Congress held in Paris in the summer of 1932: J. J. DAVIS and P. W. CLAASSEN.

Under authority of the Society at its New Orleans meeting, PRESIDENT DAVIS appointed the following to serve on the Membership Committee: D. M. DELONG, Chairman; E. O. ESSIG, ROGER C. SMITH, J. MCDUNNOUGH, HENRY BIRD, JOE WADE and O. I. SNAPP.

In accordance with the instructions of the Entomological Society at its New Orleans meeting, PRESIDENT DAVIS appointed the following committee on International Organization of Zoologists: J. C. BRADLEY, Chairman; C. P. ALEXANDER, G. F. FERRIS, HAROLD MORRISON and J. M. SWAINE.

C. H. HADLEY was appointed to act as representative of the Society on the Council of the Union of American Biological Societies.

The Executive Committee met at 5:00 P. M., December 28, in Haddon Hall, Atlantic City, New Jersey, the following officers being present: J. J. DAVIS, F. C. BISHOPP, H. B. HUNGERFORD, A. L. MELANDER, J. M. SWAINE, P. J. PARROTT; also J. S. HOUSER, E. F. PHILLIPS, and HERBERT OSBORN as alternates designated by the President.

The following were elected to membership in the Society:

H. L. BAILEY, Department of Agriculture, Montpelier, Vermont.
FRANKLIN S. BLANTON, P. O. Box 786, Babylon, L. I., N. Y.
MARK FREDERICK BOYD, P. O. Box 793, Tallahassee, Florida.
F. GRAY BUTCHER, Department Entomology, Cornell University, Ithaca, N. Y.
ERNEST N. CORY, State Entomologist, College Park, Md.
DERRILL M. DANIEL, New York Agri. Exp. Sta., Geneva, N. Y.
GEORGE GORDON DUSTAN, Dom. Ent. Lab., Vineland Station, Ont., Canada.
JOE K. ELLSWORTH, 2207 Oregon St., Berkeley, California.
A. GRAHAM BELL FAIRCHILD, Museum Comp. Zool., Cambridge, Mass.
WILLIS J. GERTSCH, Am. Mus. Nat. Hist., 77th St. and Cen. Park West, New York City.
GEORGE DE GHIKA, R. Hungarian Counsel General, 135 Wappanocca Ave., Rye, N. Y.
WILLIAM RAU HADEN, Ohio State University, Columbus, Ohio.
E. P. HASKINS, 1188 Avon Road, Schenectady, N. Y.
JAMES G. HAUB, 36 W. Lane Ave., Columbus, Ohio.
I. M. HAWLEY, Jap. Beetle Lab., Box H, Moorestown, N. J.
CHARLES F. HENDERSON, 291 Lincoln St., Twin Falls, Idaho.
W. W. HENDERSON, Agricultural Experiment Station, Logan, Utah.
DOROTHY M. JOHNSON, Ohio State University, Columbus, Ohio.
ADOLPH KLEIN, 3 Collamore Terrace, West Orange, N. J.
GUY FRANKLIN MACLEOD, Cornell University, Ithaca, N. Y.
ARTHUR P. MCKINSTRY, 1431 Boswell, Topeka, Kansas.
ARCHIE HUGH MADDEN, Box 592, Charlottesville, Virginia.
ROBERT M. MELAMPY, Cornell University, Ithaca, New York.
CARL T. PARSONS, East Street, Rye, New York.
JAMES HUBERT PEPPER, Montana State College, Bozeman, Mont.

CYRIL F. DOS PASSOS, Mendham, New Jersey.
HAZEL W. RIDDLE, State College Station, Fargo, North Dakota.
GEORGE E. SANDERS, care Ansbacker-Siegle Corp., 50 Union Square, New York City.
JOHN B. SCHMITT, Rutgers University, New Brunswick, N. J.
GEORGE K. SCHUMAKER, 1515 Chew St., Allentown, Penna.
J. K. GWYNN SILVEY, McMurry College, Abilene, Texas.
WILLIAM A. SIMANTON, Iowa State College Exp. Sta., Ames, Iowa.
CARROLL N. SMITH, Bureau of Entomology, Washington, D. C.
CHARLES E. SMITH, Bureau of Entomology, Exp. Sta., Baton Rouge, La.
G. STUART WALLEY, Entomological Branch, Ottawa, Ont., Canada.
R. L. USINGER, 5832 Ocean View Drive, Oakland, California.
W. D. WHITCOMB, Mass. St. College Exp. Sta., Waltham, Mass.

Total new members for 1932—49.

The following were elected Fellows of the Society: W. J. BAERG, S. A. GRAHAM, J. D. HOOD, G. M. LIST, B. B. FULTON, J. L. KING, ERIC HEARLE, G. P. ENGELHARDT and R. L. WEBSTER.

On the unanimous recommendation of the Executive Committee at the Atlantic City meeting in 1932, and by vote of Fellows of the Society, W. S. BLATCHLEY and W. M. WHEELER were elected Honorary Fellows of the Society.

The following have resigned during the year: G. CHARLES WOODRUFF, E. S. G. TITUS, R. J. TILLYARD, JAMES R. THOMPSON, HELEN E. MURPHY, CHARLES A. LORING, E. G. KELLY, CYRIL E. ABBOTT, W. S. FISHER, I. R. WATTS, LOUIS F. CERNY, GEO. ZEBROWSKI, M. T. TOWNSEND, E. R. SIEGLER, A. M. GILLESPIE, S. S. CROSSMAN, GEORGE SALT, L. L. ENGLISH, LAURA FLORENCE, J. W. HUNGATE, HARLAND K. RILEY, F. W. CRAIG, H. C. IRISH, SARAH KEEN ZIMMERMAN, S. ALBERT SHAW.

The following have been automatically dropped from the membership, either because of failure for three or more years to pay dues or because they cannot be reached: EDWIN SWOPE, W. B. ROBERTS, F. M. HULL, WM. A. DOUGLAS, and F. M. BROWN.

The following were elected to the Editorial Board for the term expiring December 30, 1935: P. J. PARROTT, G. F. FERRIS, and P. B. LAWSON.

In regard to the reorganization of the National Research Council, the Executive Committee voted to accept its second proposal submitted and to recommend a revised grouping so as to have the Economic Association and the Entomological Society together and the Mammalogists with the Zoologists. This means removing the American Society of Mammalogists from Group VIII and placing them in Group II with the American Society of Zoologists.

The Executive Committee voted to recommend to the Society that a summer meeting be held in Chicago in 1933.

The Executive Committee voted that as an emergency measure the interest from the Permanent Funds for the year 1933 only be used to assist in the publication of the Annals.

The Executive Committee approved the arrangements made by C. H. Kennedy with The Spahr & Glenn Co., Printers, and it was further voted that if the insertion of proper advertising matter in the Annals should be found profitable, the Committee would have no objection to this method of raising revenue.

The Executive Committee voted to contribute $50.00 to the Union of American Biological Societies for the support of Biological Abstracts.

The Executive Committee adjourned at 6:10 P. M. and held a second session following the Annual Address.

The Society has suffered the loss by death of the following seven members, during the past year:

NORMAN JEFCOATE ATKINSON, of Saskatoon, Saskatchewan, Canada, joined our Society in 1926. He was born at Rhayader, Wales, on April 11, 1902. He received two degrees from the University of Saskatoon (B. Sc. 1925 and M. Sc.

1926). Entered University of Illinois September 16, 1927, passed his prelims and began a thesis, but withdrew December 3, 1928, due to nervous disorders. After a period of recuperation in the north woods of Ontario and a visit to England, he returned to Canada, where he was employed in Biological Survey work. He met death in November of this year.

Reverend C. J. S. BETHUNE, D. C. L., a charter member and honorary fellow of this Society, died in Toronto on April 18, 1932, in his ninety-fourth year. In 1913 he was President of the Entomological Society of America, only one of many marks of achievement in his long useful career. For nearly thirty years he was the editor of the Canadian Entomologist. Three different times he served as president of the Entomological Society of Ontario, an organization he helped to found.

Following his graduation from Trinity College in 1859 at the age of twenty-one, he spent nine years in the Anglican priesthood and then became headmaster of Trinity College School, Port Hope, in 1870. Here he remained until 1899 during which time he made it one of the great boys schools of Canada. In 1906 he accepted the Chair of Entomology and Zoology at the Ontario Agricultural College, where he remained until 1920.

All during his remarkable career he manifested an active interest in insect life and has left an impress upon entomology that will long endure. Besides fostering entomological interest through his devotion to various societies, he published many papers on Systematic and Economic Entomology and stimulated and encouraged many students in this field.

In the death of Bethune the Entomological Society of America has lost a much beloved and useful member.

PERCY G. BOLSTER joined the Society in 1926. He died in Boston on May 22, 1932, following an operation for appendicitis. He received his A. B. degree from Harvard in 1886 and attended the Harvard Law School, after which he practiced law in Boston. He was a member of the Boston Bar Association, the Boston Society of Natural History and the Cambridge Entomological Club. His special entomological interest was in the Coleoptera, although he was interested also in minerals and in shells and had collections of both.

WILLIAM G. DIETZ, a charter member of our Society, died April 13, 1932, in his eighty-third year. He was born in Germany, was graduated from Heidelberg and served in the Franco-Prussian war. After the war he came to America and continued his medical studies at Hahnemann College, Philadelphia. For more than fifty years he practiced medicine at Hazleton, Pa. Entomology was a hobby to which he devoted considerable time for many years. One of his collections is in the Smithsonian Institution, Washington, D. C., another at Harvard University, and a third in the Museum of Natural History at Philadelphia. He was a writer as well as a collector.

JOHN GEORGE GEHRING, who died September 1, 1932, was born in Cleveland, Ohio, July 4, 1857. He received his training in Western Reserve University (M. D. 1885, D. Sc. 1913); University of Berlin; Bates College, LL. D. 1923. He began the practice of medicine at Cleveland, Ohio, in 1885. In 1895 he moved to Bethel, Maine, where he became the president of the Bethel National Bank; president of Gould's Academy and famous as a practitioner of the art as well as the science of medicine. His success with sufferers from nervous disorders brought him the name "The Wizard of the Androscoggin." In 1923 he published "The Hope of the Variant," a Charles Scribner's Sons book.

He joined the Entomological Society of America in 1922 and we regret the loss of another of our members who found the study of insects an interesting avocation.

WILLIAM JACOB HOLLAND, best known to most of us as the author of "The Butterfly Book" and "The Moth Book," died in December, 1932. This eminent entomologist and paleontologist was born in Jamaica, West Indies, August 16, 1848, of American parents. After graduating from Moravian College and Theological Seminary at Bethlehem, Penn., in 1867, he received the following degrees: A. B., Amherst, 1869, A. M., 1872; grad. Princeton Theological Seminary, 1874; Ph. D., 1886, Sc. D., 1902, Washington and Jefferson; D. D., Amherst, 1888;

LL. D., Dickinson, 1896, New York U., 1897, Bethany College, 1905, St. Andrew's, 1905; L. H. D., University of Pittsburgh, 1928. He taught in High Schools in Massachusetts from 1869–1871. In 1872 was ordained a minister of the Moravian Church and served as pastor in Philadelphia for two years and then became pastor of the Bellefield Presbyterian Church in Pittsburgh, which he served until 1891, when he became Chancellor of the Western University of Pennsylvania (now University of Pittsburgh) and served for ten years in that capacity. He became director of Carnegie Institute at Pittsburgh in 1898 and served to 1922 as the active head of this great institution which was built up under his direction. From 1922 until his death he was director emeritus but continued his studies at the Museum.

He was a man of strong personality and great vision. He traveled extensively in North and South America, in Europe, Asia and Africa and was internationally known, receiving honours and orders from many countries.

He was a charter member of the Society, elected Fellow in 1907 and Honorary Fellow in 1932. Through the death of Doctor Holland the Society has lost one of its greatest and most widely known members.

CHARLES WILLISON JOHNSON died July 19, 1932, at the age of 69. He also was a charter member of our Society and became a life member November 7, 1930. He was elected to fellowship in 1907, and was president of the Entomological Society of America in 1924. Mr. Johnson came to the Boston Museum of Natural History in 1903. Prior to that time he had been engaged in the study of insects, mollusca and fossils at St. Augustine, Florida, and subsequently had been curator of the Wagner Free Institute of Science in Philadelphia. His specialty was the study of the Diptera and Mollusca. He made many valuable contributions to science, his interest in the Entomological Society of America is indisputable and his loss to the Socity a matter of deep regret.

Following the reading of these brief memorials the members stood in silence in memory of the seven members who have died during the past year.

Respectfully submitted,

H. B. HUNGERFORD, *Secretary.*

On motion the Secretary's Report was accepted.

REPORT OF THE TREASURER.

CURRENT FUNDS.

RECEIPTS.

Balance, December 31, 1931 (See Annals XXV, p. 252)	$1,973.08
From Annual Dues of Members to December 20, 1932	2,390.85
Received from C. H. Kennedy, Managing Editor Annals	1,700.00
Received from Sargent for Plec. and Landis for Sarcophaga	7.00
Received from Roy Melvin for separates	5.00
Received from Life Membership	50.00
Interest on Savings Account	187.95
Interest on Liberty Bonds	14.46
Total	$6,328.34

EXPENDITURES.

Express, Secretary's books to New Orleans, to Hungerford, etc	$ 6.37
Miscellaneous Expenses, Journal, Rubber Stamps, etc	3.40
Moore Co., for Account Book Forms	3.27
Loan to Thomas Say Foundation	300.00
C. H. Kennedy (Roy Melvin Separates)	5.00
Thomas Say Foundation, Sargent for Plec., Landis for Sarcophaga	7.00
Stamps and Stamped Envelopes	100.24

Spahr & Glenn, Printing of Annals and Separates for December, 1931, March and June, 1932	3,497.63
Clerical Assistance	30.25
Reimbursement on Returned Check	6.00
Exchange Charges on Checks	7.67
Journalism Press, Printing of Letterheads, Envelopes, Dues Cards, Membership Blanks, Announcements, Programs	57.15
Oliver I. Snapp, Membership Campaign Expenses	1.30
Federal Tax on Checks at .02 each	.30
	$4,025.58
Transferred to Permanent Fund—One Life Membership	50.00
Transferred to Permanent Fund—Part Interest, Bonds and Sav. Acc't.	152.41
Total	$4,227.99
Balance in Bank	2,100.35
	$6,328.34

LIABILITIES.

The Society owes the publishers for the September and December, 1932, Annals. Of the above cash receipts for dues, $1,019.00 is for 1933 dues.

PERMANENT FUND.

Liberty Bonds (Annals XXIII, p. 202)	$ 350.00
In Savings Account of Peoples State Bank, Lawrence, Kansas	2,433.11
One Life Membership	50.00
Part Interest on Liberty Bonds and Savings Account	152.41
	$2,985.52

RESOURCES.

Liberty Bonds	$ 350.00
Savings Account, Peoples State Bank, Lawrence, Kansas	3,035.52
Balance in Checking Account, Peoples State Bank	1,700.35
	$5,085.87

Of the total resources, $2,985.52 is in the Permanent Fund and $2,100.35 in Current Fund—TOTAL, $5,085.87.

In addition to the above the Thomas Say Foundation is in debt to the Society to the extent of $500.00.

Respectfully submitted,

H. B. HUNGERFORD, *Treasurer.*

On motion the Treasurer's Report was accepted, subject to the approval of the Auditing Committee.

REPORT OF THE MANAGING EDITOR OF THE ANNALS.

I wish to report that 848 pages of matter has been published in Volume 25 for 1932 as against 942 pages for 1931. Thus the volume is nearly 100 pages less in size than that for 1931, which was the largest volume ever published by the Society.

We wish to thank the National Academy of Science for a grant of $500.00, which has aided the Annals materially, and to repeat our thanks for the several grants given during the preceding series of years.

We are calling the attention of the Society to the lessened income of the Annals for the past year and the probability of an even more lessened income for the year to come. The National Academy of Science has notified us that they will be unable to make a grant for the year 1933. Sales of back volumes have fallen off, those for 1932 being $262.00 as against $716 for 1931, a difference of over $400.00. The Secretary-Treasurer reports that more than 125 members have failed to pay dues for 1932. However, subscriptions have held up well, as there have been eight new ones, while 15 have been dropped, making a loss of seven and a total of 189 active subscriptions.

It looks as though the income of the Annals would be down about $1,000.00 for 1933 as against the high year of 1931, when about $3,800.00 was spent in publishing. Spahr and Glenn have decreased prices 8½% during the past year, which will offset losses about $250.00 on the 1933 volume and which will leave an anticipated loss of $750.00 plus.

Mr. Birley J. Landis has been appointed Assistant Managing Editor, which will mean better proof reading and a more consistent makeup in future numbers of the Annals. The financial summary follows:

RECEIPTS.

From Non-member Subscriptions	$ 660.38
From Sale of Back Volumes, Numbers and Reprints	262.35
From Author's Reprints and Etchings	1,110.28
From National Academy of Science	500.00
Total Receipts	$2,533.01
Balance in Bank, December 18, 1931	71.10
Check to O. S. U., December 5, 1932, not in Bank December 15, 1932	15.00
	$2,619.11

DISBURSEMENTS.

Engraver's Bills	$ 404.74
Stenographic Services	261.58
Work on Stocks in Annals Closet (moving to new quarters, etc.)	59.09
Fourth Class Postage	66.64
Stamps, Stationery and Sundries	79.41
Exchange on Foreign Checks	3.54
Express	3.17
Paid Out for Back Numbers (Vol. XIX, etc.)	7.00
Wrappers	23.75
Three Checks to Secretary-Treasurer	1,700.00
Tax Charges on Checks	.16
Total Disbursements	$2,609.08
Balance in Bank, December 15, 1932	10.03
	$2,619.11

Vouchers are submitted herewith.

Respectfully submitted,

CLARENCE H. KENNEDY, *Managing Editor.*

On motion the report was adopted subject to the approval of the Auditing Committee.

REPORT OF THE TREASURER OF THE THOMAS SAY FOUNDATION.

FOR THE YEAR 1932.

RECEIPTS.

Balance on hand January 1, 1932	$ 891.61
Received as Loan from Entomological Society of America	300.00
Received from 1931 Sales of Vol. 1	5.70
Received from 1931 Sales of Vol. 2	18.50
Received from 1931 Sales of Vol. 3	43.20
1932 Sales of 8 Copies of Vol. 1	23.90
1932 Sales of 7 Copies of Vol. 2	34.00
1932 Sales of 60 Copies of Vol. 3	193.13
Unaccounted for	2.00
Interest on Savings Deposits	15.06
	$1,527.10

EXPENDITURES.

Geo. Banta Pub. Co., for Publication of Vol. 3	$1,174.70
Geo. Banta Pub. Co., for Two Interleaved Copies, Vol. 3	8.47
To J. J. Davis, Balance on Loan	125.00
To C. C. Thomas, Commission on Sale of Books	13.00
Copyright for Vol. 3	2.00
Refund on Exchange of Canadian Checks	.27
Stamps	2.00
Postage on Mailed Volumes	10.87
Total Expenditures	$1,336.31
Balance in Bank	190.79
	$1,527.10

There is a balance due on the loan from the Entomological Society of America of $500.00.

Respectfully submitted,

J. J. DAVIS, *Treasurer.*

On motion the Report was accepted subject to the approval of the Auditing Committee.

REPORT OF THE AUDITING COMMITTEE.

We, the undersigned members of the Committee on Auditing, beg to report that we, after a careful examination of the books of the Treasurer, the Managing Editor of the Annals, and The Treasurer of the Thomas Say Foundation, have found them to be correct and properly balanced.

Respectfully submitted,

H. O. DEAY, *Chairman,*
D. M. DELONG,
P. A. READIO.

On motion the Report of the Auditing Committee was accepted.

REPORT OF THE MEMBERSHIP COMMITTEE.

The Membership Committee wishes to report that 49 new members have been secured for 1932

D. M. DELONG, *Chairman,*
E. O. ESSIG,
ROGER C. SMITH,
J. MCDUNNOUGH,
HENRY BIRD,
JOE WADE,
O. I. SNAPP.

REPORT OF THE NOMINATIONS COMMITTEE.

The Nominating Committee begs to report the following names as nominees for the respective offices for the year 1933:

President—R. E. SNODGRASS.

First Vice-President—W. B. HERMS.

Second Vice-President—C. H. RICHARDSON.

Secretary-Treasurer—H. B. HUNGERFORD.

Additional Members of the Executive Committee—For the term expiring December 31, 1935: EDITH M. PATCH and F. C. BISHOPP.

Councilor to the American Association for the Advancement of Science—P. J. PARROTT and ARTHUR GIBSON.

Respectfully submitted,

FRANK E. LUTZ, *Chairman*,
G. M. BENTLEY,
H. E. EWING.

On motion the report was accepted and the Secretary instructed to cast a ballot for the election of the persons nominated. This being done they were duly elected.

The Committee on Insect Collections reported as follows:

REPORT OF THE COMMITTEE ON INSECT COLLECTIONS.

In order to secure reports from various institutions a request was sent as usual for reports concerning additions in the various collections and replies have been received from a number with the brief reports of additions, while a number of institutions reply simply that no additions of importance have been made during the year. Whether this indicates the let-up in the activity on this phase of entomological work may be a question, but it appears that for many institutions the reports of previous years have set forth the conditions of the collection quite fully and that further reports are unnecessary at the present time. It is evident that there has been considerable activity in exploration and collecting with some quite notable advances in the condition of a number of important collections.

Owing to the death of Mr. C. W. Johnson, who has been a faithful member of the committee for many years, and the absence of Dr. Van Dyke in Europe, it has been possible for the Chairman to submit this report to only two other members of the committee. Mr. Johnson's association with the committee will be greatly missed and the selection of a successor should be given careful consideration. Your Chairman, having served on the committee for over ten years, since 1921, feels that some new blood in this position would be useful and would be pleased to be retired from the committee.

U. S. National Museum, Washington, D. C.: R. C. Shannon donated to the National Museum about 14,000 insects, mostly Diptera, collected by him in Southern Chile and Argentina in the year 1926. L. D. Christensen, Wellsville, Utah, was successful in getting for the Museum approximately 4,550 insects, mostly beetles, when the Cuba Sugar Experiment Station was closed during the past year; this came through correspondence with Dr. E. A. Chapin, on the Taxonomic staff of the Bureau of Entomology. A. Busck, of the Bureau of Entomology, while in Europe attending the Entomological Congress, obtained about 600 valued micro-lepidoptera from the British Museum; and as many more from Mr. Edward Meyrick, of Marlborough, England, making in all a very valuable addition in this group. Mr. Frank Johnson, of New York, through Dr. Wm. Schaus, of the Taxonomic staff, has continued his donations of very rare and beautiful Lepidoptera throughout the year, amounting to several hundred. Also through Dr. Schaus the Museum has received about 1,000 Lepidoptera from Commander C. M.

Dammers, Riverside, California. Dr. Hugh M. Smith has continued to send Siamese insects, the specimens received during the year numbering about 800. Each year the Bureau of Entomology transfers to the Museum collections the material retained out of the many hundreds of shipments sent to the Division for identification; some of which is quite rare. The various transfers this year numbered about 18,000.

J. M. ALDRICH, *Associate Curator*, Division of Insects.

The American Museum of Natural History, New York City: About 21,000 specimens of insects and spiders have been received since our 1931 report. The most outstanding accession among these is the Dr. R. Ottolengui collection of about 3,300 specimens of *Plusia* and allied genera, containing approximately 450 species and including type material of several species. This collection is accompanied by an album containing 171 water color drawings of types and rare species.

Other collections of note consist of 4,000 or more spiders collected by W. J. Gertsch on Long Island, 3,000 Diptera collected by C. H. Curran, about 2,400 specimens, mostly Coleoptera, from the Central Asiatic Expedition, more than 2,000 European beetles, including 544 named species, from Mr. Geo. B. Walsh, and about 2,000 Lepidoptera donated by Mr. Frank Johnson. The type collection has, during the past year, been increased by at least 250 species, due not only to publications by staff members, but also to workers who have co-operated with the Museum in publishing articles based on our material and to others who have donated representatives of their type series.

MR. A. J. MUTCHLER, through FRANK E. LUTZ.

Museum of Comparative Zoology: The most important accession during the year was the collection of Mr. A. G. Weeks, butterflies of the world. It includes about 13,000 named forms, and types of about 200 species. It is in excellent condition. We have also received the collection of Coleoptera and Hymenoptera of the late Percy Gardner Bolster; about 60,000 specimens, there are but two types—bumblebees. It is especially useful for the great amount of Newfoundland material. The return of Dr. Wheeler from Australia in the spring brought the first part of the Australian material; from this over 10,000 specimens outside of Coleoptera have been mounted. Mr. Darlington returned in the early fall with a still larger amount of material, not yet mounted. About 2,000 additional named insects from Morocco and Algiers were sent by Dr. Franz Werner; over 2,000 were brought back by Mr. Donald Wees from northern Paraguay, and about 3,000 were given by Dr. C. R. Kellogg from Foochow, China. Dr. Carpenter has collected a great number of fossils and several thousand recent insects from Kansas, Texas, etc. Messrs Bates and Fairchild collected several thousand in Cuba, largely Lepidoptera. The Curator gathered about 2,000 insects in the White Mountains, and there were many smaller lots of material, the principal being gifts at various times from Dr. J. Bequaert, of Diptera and Hymenoptera from various places. Dr. L. Worley has presented his collection of Western and Cuban spiders.

NATHAN BANKS.

The University of Nebraska, Lincoln, Nebraska: The rearrangement of the insect collection has continued through 1932. A moderate amount of new material from Nebraska has been added. The collection of North American Orthoptera is being completely rearranged and identified by Mr. Harold Hauke, while Mr. Charles F. Keech is doing the same for the Odonata.

MYRON H. SWENK, *Chairman*, Department of Entomology.

Utah Agricultural College, Logan, Utah: During the year approximately 13,000 pinned specimens have been added to the Station collection, including 3,800 Orthoptera, collected principally by Dr. W. W. Henderson, 4,000 miscellaneous insects collected by the staff, gifts of : 1,600 labeled specimens by W. L. Thomas, 1,500 by F. K. Stoffers, 1,400 by L. Cutler, and 600 by M. D. Hammond. Approximately 300 slides of aphids have been prepared. The addition of a new cabinet, cases and trays, and some rearrangement has put the insect collection in better condition than has been the case for several years.

G. F. KNOWLTON, *Associate Entomologist*, In Charge of Insect Collection.

University of Minnesota: Approximately ten thousand specimens of insects have been added to the collection during the past year. About half of this number were acquired through gifts, purchases, or exchanges and came, principally, from other parts of the United States and other countries of the world. The other half, or approximately five thousand specimens, were collected in the State of Minnesota by members of the Staff. All of the Orthoptera in the collection have been studied by Mr. Morgan Hebbard and an Experiment Station Technical Bulletin is now in press giving the results of his study. Material in the following groups has been studied and identified during the year: Phymatidae, Silphidae, Phyllophaga, Lucanidae, Lepturini, Tachinidae, and Bombidae. A large amount of other material is being studied at present, but work on it is not yet completed. One Experiment Station Technical Bulletin has been published during the year dealing with the Tabanidae of Minnesota by Dr. C. B. Phillip. A large amount of material is available for study in most groups of insects.

CLARENCE E. MICKEL.

Brigham Young University, Provo, Utah: During the past year 18,000 insect specimens were added to the Brigham Young University collection. A collecting party consisting of C. Lynn Hayward, Lee Jeppson, Elmer Johnson, under the direction of the writer, collected 10,750 specimens in southeastern Utah and Colorado. Mr. C. A. Frost, of Farmingham, Massachusetts, sent 1,000 specimens of weevils to the writer, and Mr. Walter R. Sweadner, graduate student of the University of Pittsburgh, contributed 250 specimens of Lepidoptera from eastern United States to our collection.

VASCO M. TANNER.

Illinois State Natural History Survey, Urbana, Illinois: The principal additions to the Survey collections this year have been about 9,000 specimens of Miridae, 1,000 specimens of Orthoptera, and 8,000 miscellaneous pinned specimens, giving a total addition of 18,500 pinned insects from various parts of Illinois. Dr. V. W. Balduf has donated to the Survey his personal collection of the chalcid genus *Decatoma*, consisting of 550 pinned specimens and 125 slides. Six hundred slides of Aphiidae, Thysanoptera and Mallophaga have been added, and considerable alcoholic material, as follows: 250 vials of Plecoptera, 80 of Mallophaga, 25 of Anoplura, 25 of Siphonaptera and 300 of miscellaneous insects. Typic material in the following groups has been added to the collection: 20 species of Chalcidoidea, 15 of Aphiidae, 26 of Ephemeroptera, 10 of Xyelidae and Tenthredinidae and 6 of Plecoptera.

HERBERT H. ROSS, *Systematic Entomologist.*

Cornell University, Ithaca, New York: Important acquisitions in 1932—Large quantities of Lepidoptera, chiefly butterflies received from the British Museum, including particularly rich representation of Australasian Trapezitinae, a fine set of Ismeninae, etc. The Lepidoptera collection of R. Vitalis de Salvaza (exclusive of butterflies and Sphingidae), 3,000 or more specimens, mostly determined by Salvaza, representative of the fauna of southeastern Asia. An extensive collection, largely alcoholic, of European lepidopterous larvae and pupae, from Dr. Alfonso Dampf. An enormous collection, many thousands of specimens of Philippine dragonflies, received from the Philippine Bureau of Science (Dr. R. C. MacGregor), the Experiment Station at Laguna (A. C. Hadden) and from Dr. L. B. Uichanco, of the Agricultural College at Los Banos.

J. CHESTER BRADLEY, *Curator.*

Clemson College, South Carolina, (the land-grant college): Little change since last year. Our collections are intended to illustrate the state fauna, with card-catalogue in connection which gives many additional records. We use Schmitt-type boxes chiefly, of which we have about 400. We have perhaps 2,200 identified species in our collections, and total state list now shows 3,700 (plus) species. In our locality mold on specimens and rust on pins are more destructive than dermestids.

FRANKLIN SHERMAN.

Indiana University Insect Collections: The general collections are being gradually expanded for use in routine class teaching and by research students.

The gall wasp collection has been augmented by about one hundred thousand specimens obtained chiefly from Mexico, where a party from this institution engaged in field work for four months during the past year.

A. C. KINSEY.

The Francis Huntington Snow Entomological Museum, University of Kansas: Since last year's report Mr. Warwick Benedict has continued his work with the Coleoptera, adding 926 species new to the collection, including 2 types and 2 paratypes. He has up to this date increased the collection by 1872 species. Doctor R. H. Beamer, who spent his vacation in the Southwestern United States, returned with approximately 10,000 insects, a number of which have already proved to be new to our collection or new to science. Considerable material, mostly Hemiptera, has been received from Mexico, Central America, Insular America and South America: The following type materials have been added during the year: Hemiptera, type species 6, type specimens 36; Homoptera, type species 116, type specimens 3,780; Diptera, type species 13, type specimens, 28.

H. B. HUNGERFORD.

North Carolina State College of Agriculture and Engineering: During the past year this institution has added materially to its collection of insects of North Carolina and has also received extensive collections of Homoptera from the Philippine Islands, East Africa, Brazil, Central America and Cuba. As most of this material is pinned but has not yet been sorted, I would hesitate to make even an estimate of the specimens or species.

Z. P. METCALF.

Committee: HERBERT OSBORN, *Chairman*,
NATHAN BANKS,
J. G. NEEDHAM.

REPORT OF COMMITTEE ON RESOLUTIONS.

Your committee submits the following resolutions:

1. *Resolved*, That we express our hearty appreciation to Doctor O. A. Johannsen for the excellent arrangements that were made for the Fifth International Congress of Entomology.

2. *Resolved*, That the Society express its deep appreciation to Doctors Bradley and Claassen, who gave freely of their time and expended much effort to make the trip to Europe both profitable and enjoyable.

3. *Resolved*, That the Society express its appreciation of the work of the Local Committee composed of Messrs. Headlee and Hadley, who made such splendid arrangements for our meetings and entertainment at Atlantic City.

4. *Resolved*, That the Society send felicitations to Doctor L. O. Howard.

P. J. PARROTT, *Chairman*,
C. H. RICHARDSON,
G. F. MACLEOD.

C. H. HADLEY gave an oral report of the meeting of the Union of Biological Sciences.

J. J. DAVIS gave a brief report of the International Entomological Congress held in Paris in July, 1932, to which he and P. W. CLAASSEN were delegates from the Society.

By vote of the Society, J. G. REHN was elected a member of the Committee on Insect Collections to replace C. W. JOHNSON, deceased.

It was voted by the Society to hold a summer meeting at Chicago in connection with the summer meeting of the A. A. A. S., which meets the last full week in June, 1933.

The Society voted to amend Section 4 of Article V of the Constitution by omitting the last sentence.

Following the transaction of the above business, the meeting adjourned.

The exhibit of Butterflies and their Ultraviolet Photographs prepared by FRANK E. LUTZ, attracted considerable attention.

Thursday evening, December 29, the members met with the American Association of Economic Entomologists for the Annual Entomologists' Dinner. W. C. O'KANE acted as toastmaster and a number of interesting talks were given by entomologists who had traveled the world over on entomological work.

Respectfully submitted,

H. B. HUNGERFORD, *Secretary.*

BOOK NOTICES

HUNTING INSECTS IN THE SOUTH SEAS, by EVELYN CHEESMAN, pp. i–xi and 1–243, with text figures and eight plates. 1933. Published by Robert O. Ballou, 347 Fifth Avenue, New York City.

The volume is a running description of the high points of the author's experiences while collecting insects in the Low Archipelago, the Marquesas and Society Islands during 1924–25 and in the New Hebrides in 1929–30. It gives one a vivid picture of the "bush" and of the rain forests of this little known region. Miss Cheesman has a remarkable choice of words and a style that is enjoyable in its fluent ease. The reviewer dipped into the book to get data for a book notice and read the volume from cover to cover without stopping. The reader is not held up by scientific names in every other sentence or detailed inconsequential observations. It is not a scientific work in life history studies of insects in this region. It is a book for a comfortable chair and a pleasant evening. The chapter headings indicate the subjects: I, Potter wasps; II, Friendly butterflies; III, Caterpillars; IV, Cocoons; V, Violets on Tahita; VI, Mosquitoes and sandflies; VII, Praying mantises and stick insects; VIII, Fireflies; IX, Bees; X, Aquatic insects; XI, Lake Omav; XII, The Bush of the New Hebrides; XIII, A night in the bush; XIV, Encamping; XV, A climbing adventure on the Marquesas Islands.

We recommend the volume to those entomologists who enjoy collecting and sweating in the tropical jungle, vicariously, and as well to those who dream of the days when they can go and do their own collecting.—C. H. K.

INSECTS, MAN'S CHIEF COMPETITORS, by W. P. FLINT AND C. L. METCALF, pp. i-viii and 1–133 with 12 text figures, 1932. Published by The Williams and Wilkins Company, Baltimore. Price, $1.00.

This is one of the series of small volumes of "The Century of Progress Series" which are being published to give the general reader a glimpse and short review of the progress of science in the past century as will be shown by the Century of Progress International Exposition at Chicago. The series of booklets is a co-operative enterprise of a Committee of the National Research Council and the Trustees of the Exposition, but are published privately by Williams and Wilkins.

The authors have entered what the Editor feels is the most difficult field of entomological writing. They have tried to put the problem of the relationship of the insects to man before the public in a simple and readable form. To paraphrase an old figure of speech, the average writer of such a volume usually cannot see the problem because of the vast number of insects. The authors have stated simply the general situation and then have dealt in some detail with seven outstanding problems, The Grape Phylloxera, Fleas and Black Death, Ox Warbles, The Hessian Fly, The Seventeen-year Locust, The Colorado Potato Beetle and the Cotton Boll Weevil. These chapters are interestingly done by emphasis on the costs in money and life and other very human aspects. Chapter IV, "What Is It?" is an attempt to describe the hordes of insects as an army; each Order is a Battalion, which is interestingly described as it passes in review. It is systematic entomology in the most easily read form in which we have seen it. We believe the volume will have a popular appeal. We certainly need such books. Unfortunately there is no general amateur interest in entomology with us as exists in England and on the Continent. Probably the fault lies in our secondary system of education. We should have a wide interest of this kind in America as our fauna is so much richer than the European. Any book of this type helps bring us nearer to a realization of such a popular interest.

The volume is beautifully printed and artistically bound as is characteristic of the Williams and Wilkins products.—C. H. K.

IN DAYS AGONE, by W. S. BLATCHLEY, pp. 1–338, 15 Plates. Published by The Nature Publishing Co., Indianapolis, Ind. 1932.

The subtitle, "Notes on the Fauna and Flora of Subtropical Florida in the Days when most of its Area was a Primeval Wilderness," indicates the general nature of the contents of the volume. The text is in diary form, but is divided into six parts as follows: I, Around the coasts of southern Florida—1911, pp. 9–169; II, The Okeechobee wilderness—1918, pp. 170–253; III, Again the Okeechobee wilderness—1918, pp. 254–270; IV, The southern tip of the United States—1919, pp. 271–297; V, The lower west coast and ten thousand islands—1921, pp. 298–315, and, VI, Okeechobee for the last time—1922, pp. 316–331. The author gives picture after picture of the very primitive native life of the wilder parts of Florida before the days of the automobile and the invasion of the northern tourists. Woven into this back-ground are numberless notes on the local fauna and flora. Probably few naturalists today have such a varied knowledge of plants and animals in the field as does Doctor Blatchley. The reader is given the benefit of this detailed knowledge. It is a book for one planning a collecting trip to Florida and will be of interest to every field-minded entomologist.—C. H. K.

PLANT SOCIOLOGY, by J. BRAUN-BLANQUET. Pages i–xviii and 1–439, with 180 text figures. 1932. Translated, revised and edited by George D. Fuller and Henry S. Conard. Published by McGraw-Hill Book Company, Inc., New York and London.

This volume is the "Pflanzensoziologie" of Dr. J. Braun-Blanquet, Director of the Station Internationale de Geobotanique Mediterraneenne et Alpine, at Montpellier, France. The English translation is by Professor Fuller, of Chicago University, and Professor Conard, of Grinnell College, which makes available to American students of ecology the most notable recent European volume on the subject. Because of the lack of extended natural stands the European studies of plant ecology have centered largely on the factors that control the association of species rather than on a plant geography, mapping and defining larger units. The use of sample plots, quadrats and such other methods has been more highly developed in Europe. Also with the larger types of vegetation long destroyed or otherwise modified by man work centered more on herbaceous forms. The fifteen chapters are divided into groups under the following section headings: Part I. The basis of social life among plants, Chap. I; Part II. Organization of plant communities, Chap. III; Part IV. Synecology or community economics, Chaps. V–XII; Part IV. Syngenetics, Chap. XIII; Part V. Synchorology, Chap. XIX, and Part VI. Systematics of Phytosociology, Chap. XV. There is a bibliography of twenty-eight pages and an index of thirty-three pages. This volume will be of great interest to all entomologists studying the natural habitats of insects and to all workers in experimental ecology whether of plants or insects. It is a very well chosen addition to the McGraw-Hill series of texts on ecology.

C. H. K.